Bottom Sheathing

Position bottom sheathing and nail crosswise to the base (at right angles to the direction of the side sills). Space the boards 1/4 to 3/8 inch apart for drainage. Use boards 4 to 10 inches wide. For the forklift area (42 in. from each end of the base) use 2 inch lumber. Use one piece sheathing boards and extend them 1/2 to 5/8 of an inch beyond the outside faces of the side and end sills. Place at least one diagonal in the unsheathed portion of the base.

Rubbing Strips

Position rubbing strips lengthwise to the crate under each longitudinal sill. Rubbing strips are always 2 inches thick and not less than 4 inches wide. The clear distance between rubbing strips should not exceed 30 inches. Cut sling notches 8 inches long in each end of the rubbing strip. Use filler strips in the unsheathed area between the sill and the rubbing strip where voids occur.

Sides

The sides consist of upper and lower frame members, vertical struts, horizontal braces, diagonals, and gusset plates (fig 6-45).

Design of the Side Panels

Determine the design of the side panel from the inside length and inside height of the crate. For crates up to 48 inches inside height use an X type frame and for crates with an inside height of over 48 inches use a HK type frame.

Member Selection

Determine the sizes of the upper and lower members, struts, and diagonals from tables 6-20 and 6-21 with the exception of the end strut or corner post. Loads referred to in the table are based on the net weight of the contents and the inside dimensions of the crate. If the exact size of the crate is not given in the table, use the member size for the crate of the next longer length, the neat greater width, and next smaller height.

Use 1 X 4 inch lumber for members and diagonals and 2 X 4 inch lumber for upper edge members when the height of the crate is 6 feet or less and the load does not exceed 4,000 pounds. Use 1 inch lumber for the lower edge members, struts and diagonals, and 2 inch lumber for the upper edge members and end struts when the height of the crate is under 6 feet and the load is over 4,000 pounds. Use 2 X 4 inch lumber for the upper and lower edge members, struts and diagonals, when the height of the crate is over 6 feet.

Upper, Lower, and Intermediate Members

The members are required to be a single continuous piece. If splicing is required, splice the members according to the details shown in figure 6-54. All splicing should be made under or over a strut whenever possible. Splicing 1 inch material is not permitted. The size of these members is based upon the gross weight and length of the crate. Intermediate members (horizontal braces) are used only for crates of the HK type.

Table 6-20. Panel Member Selection (6,000, 8,000 and, and 10,000 Pounds Net Load)[1]

Length	Members	Net load	4-foot width				6-foot width			8-foot width				
			Height (feet)				Height (feet)			Height (feet)				
			2	4	6	8	2	4	6	8	2	4	6	8
Feet		*Pounds*												
6	Upperframe members	6,000	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4
	Lower frame members	6,000	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4
	Struts	6,000	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4
	Diagonals	6,000	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4
8	Upper frame member	6,000	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4
	Lower frame member	6,000	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4
	Struts	6,000	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4
	Diagonals	6,000	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4
10	Upper frame member	6,000	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4
	Lower frame member	6,000	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4
	Struts	6,000	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4
	Diagonals	6,000	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4
12	Upper frame member	6,000	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4
	Lower frame member	6,000	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4
	Struts	6,000	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4
	Diagonals	6,000	.....	.....	.....	2 X 4	.....	.....	.....	2 x 4	.....	.....	.....	2 X 4
16	Upper frame member	6,000	2 X 6	2 X 4	2 X 4	2 X 4	2 X 6	2 X 4	2 X 4	2 X 4	2 X 6	2 X 4	2 X 4	2 X 4
	Lower frame member	6,000	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4
	Struts	6,000	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4
	Diagonals	6,000	.....	.....	.....	2 X 4	.....	.....	.....	2 x 4	.....	.....	.....	2 X 4
6	Upper frame member	8,000	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4
	Lower frame member	8,000	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4
	Struts	8,000	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4
	Diagonals	8,000	.....	.....	1 X 6	2 X 4	.....	.....	1 x 6	2 x 4	.....	.....	1 X 6	2 X 4
8	Upper frame member	8,000	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4
	Lower frame member	8,000	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4
	Struts	8,000	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4
	Diagonals	8,000	.....	.....	1 X 6	2 X 4	.....	.....	1 x 6	2 x 4	.....	.....	2 X 4	2 X 4
10	Upper frame member	8,000	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4
	Lower frame member	8,000	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4
	Struts	8,000	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4
	Diagonals	8,000	.....	.....	1 X 6	2 X 4	.....	.....	1 x 6	2 x 4	.....	.....	1 X 6	2 X 4
12	Upper frame member	8,000	2 X 6	2 X 4	2 X 4	2 X 4	2 X 6	2 X 4	2 X 4	2 X 4	2 X 6	2 X 4	2 X 4	2 X 4
	Lower frame member	8,000	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4
	Struts	8,000	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4
	Diagonals	8,000	.....	.....	1 X 6	2 X 4	.....	.....	1 x 6	2 x 4	.....	.....	1 X 6	2 X 4
16	Upper frame member	8,000	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4
	Lower frame member	8,000	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4
	Struts	8,000	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4
	Diagonals	8,000	.....	.....	1 X 6	2 X 4	.....	.....	1 x 6	2 x 4	.....	.....	1 X 6	2 X 4

Table 6-20. Panel Member Selection (6,000, 8,000 and, and 10,000 Pounds Net Load)[1] (Continued)

Length	Members	Net load	4-foot width				6-foot width			8-foot width				
			Height (feet)				Height (feet)			Height (feet)				
			2	4	6	8	2	4	6	8	2	4	6	8
Feet		*Pounds*												
6	Upper frame members	10,000	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4
	Lower frame members	10,000	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4	.....	.....	2 X 4	2 X 4
	Struts	10,000	.....	.....	.....	2 X 4	.....	.....	1 x 6	2 X 4	.....	1 X 6	2 X 4	2 X 4
	Diagonals	10,000	.....	.....	1 X 6	2 X 4	.....	.....	1 X 6	2 X 4	1 X 6	.....	1 X 6	2 X 4
8	Upper frame member	10,000	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4
	Lower frame member	10,000	.....	.....	2 X 4	2 X 4	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4
	Struts	10,000	.....	.....	2 X 4	2 X 4	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4
	Diagonals	10,000	.....	1 X 6	2 X 4	2 X 4	1 X 6	1 X 6	1 X 6	2 X 4	1 X 6	1 X 6	1 X 6	2 X 4
10	Upper frame member	10,000	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4
	Lower frame member	10,000	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4	.....	.....	.....	2 X 4
	Struts	10,000	.....	.....	1 X 6	2 X 4	.....	.....	1 X 6	2 X 4	.....	.....	1 X 6	2 X 4
	Diagonals	10,000	.....	1 X 6	1 X 6	2 X 4	1 X 6	1 X 6	1 X 6	2 X 6	1 X 6	1 X 6	1 X 6	2 X 6
12	Upper frame member	10,000	2 X 6	2 X 4	2 X 4	2 X 4	2 X 6	2 X 4	2 X 4	2 X 4	2 X 6	2 X 4	2 X 4	2 X 4
	Lower frame member	10,000	.....	.....	.....	2 X 4	.....	.....	2 X 4	2 X 4	.....	.....	2 X 4	2 X 4
	Struts	10,000	.....	.....	1 X 6	2 X 4	.....	.....	1 X 6	2 X 4	.....	.....	1 X 6	2 X 4
	Diagonals	10,000	.....	1 X 6	1 X 6	2 X 4	1 X 6	1 X 6	2 X 4	2 X 4	1 X 6	1 X 6	2 X 4	2 X 4
16	Upper frame member	10,000	2 X 8	2 X 6	2 X 4	2 X 4	2 X 8	2 X 6	2 X 4	2 X 4	2 X 8	2 X 6	2 X 4	2 X 4
	Lower frame member	10,000	.....	.....	.....	2 X 4	.....	.....	2 X 4	2 X 4	.....	.....	2 X 4	2 X 4
	Struts	10,000	.....	.....	.....	2 X 4	.....	.....	2 X 4	2 X 4	.....	1 X 6	2 X 4	2 X 4
	Diagonals	10,000	1 X 6	1 X 6	1 X 6	2 X 4	1 X 6	1 X 6	2 X 4	2 X 4	1 X 6	1 X 6	2 X 4	2 X 6

[1]All blank spaces are 1 X 4's

Note. See text for size of end struts of sides.

Table 6-21. Panel-Member (Selection (12,000 Pound Net Load))[1]

Length	Members	Net load	4 foot width			6-foot width			8 foot width		
			Height (feet)			Height (feet)			Height (feet)		
			4	6	8	4	6	8	4	6	8
Feet		*Pounds*									
6	Upper frame members	12,000	.....	.....	.....	.....	.....	.....	.....	.....	.....
	Lower frame members	12,000	.....	.....	.....	.....	.....	.....	.....	.....	.....
	Struts	12,000	.....	.....	.....	.....	.....	.....	.....	.....	.....
	Diagonals	12,000	.....	.....	(*)	.....	.....	(*)	.....	(*)	(*)
8	Upper frame member	12,000	.....	.....	.....	.....	.....	.....	.....	.....	.....
	Lower frame member	12,000	.....	.....	.....	.....	.....	.....	.....	.....	.....
	Struts	12,000	.....	.....	.....	.....	.....	.....	.....	.....	(*)
	Diagonals	12,000	.....	(*)	2 X 6	.....	(*)	2 X 6	.....	(*)	2 X 6
10	Upper frame member	12,000	.....	.....	.....	.....	.....	.....	.....	.....	.....
	Lower frame member	12,000	.....	.....	.....	.....	.....	.....	.....	.....	.....
	Struts	12,000	.....	.....	.....	.....	.....	(*)	.....	.....	2 X 6
	Diagonals	12,000	.....	2 X 6	2 X 6	.....	2 X 6	2 X 6	.....	2 X 6	2 X 6
12	Upper frame member	12,000	.....	.....	.....	.....	.....	.....	.....	.....	.....
	Lower frame member	12,000	.....	.....	.....	.....	.....	.....	.....	.....	.....
	Struts	12,000	.....	.....	.....	.....	.....	2 X 6	.....	2 X 6	2 X 6
	Diagonals	12,000	.....	.....	2 X 6	.....	2 X 6	2 X 6	.....	2 X 6	2 X 6
16	Upper frame member	12,000	.....	.....	.....	.....	.....	.....	.....	.....	.....
	Lower frame member	12,000	.....	.....	.....	.....	.....	.....	.....	.....	.....
	Struts	12,000	.....	.....	.....	.....	.....	2 X 6	.....	.....	2 X 6
	Diagonals	12,000	.....	.....	2 X 6	.....	.....	2 X 6	2 X 6	2 X 6	2 X 6

NOTES:
1. All blank spaces are 2/4's.
* The above sizes are for uniform loads but apply also to concentrated loads where an asterisk is shown. When asterisk is shown, increase the member size to 2x6 for concentrated load.

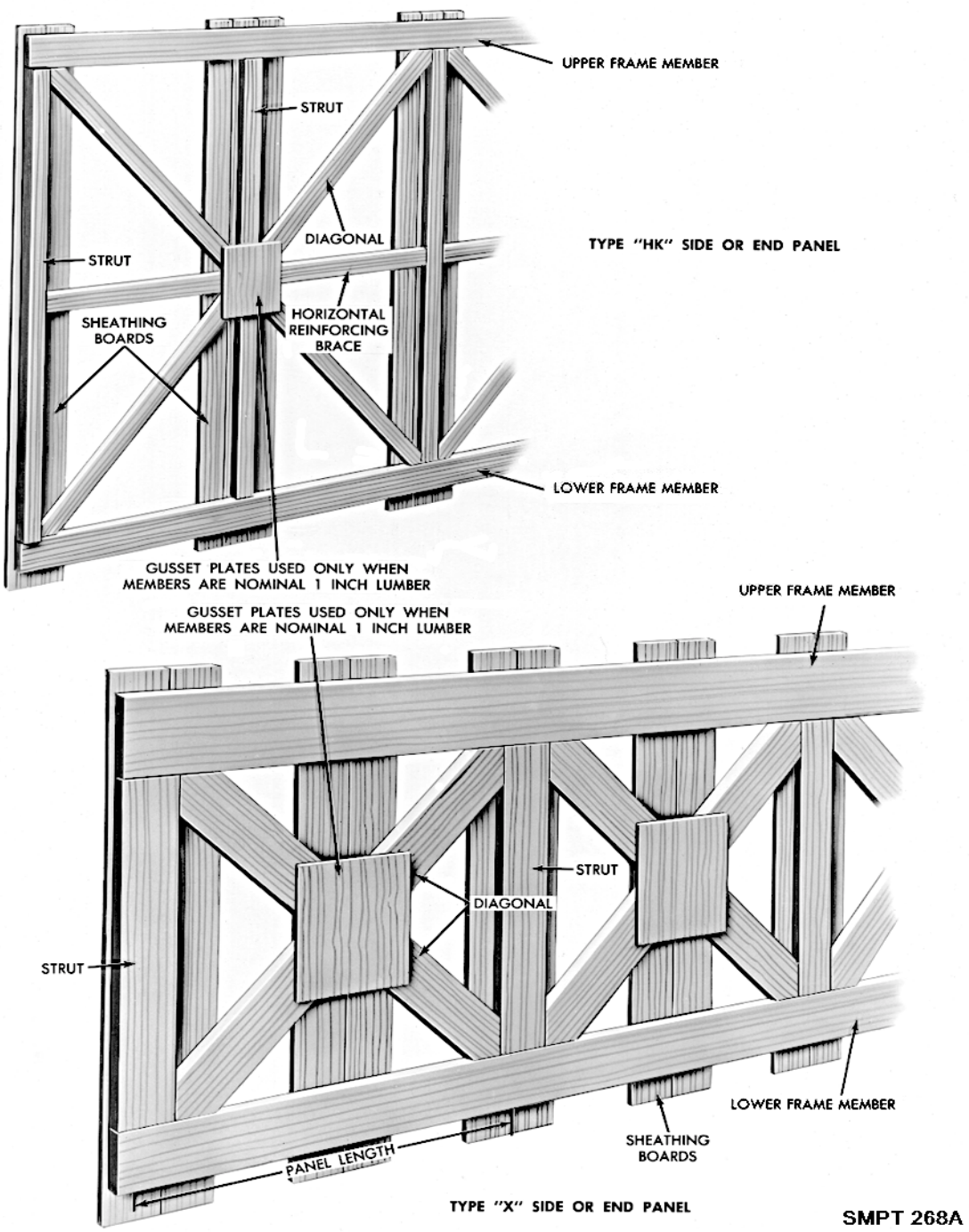


Figure 6-45. Side or end panel for nailed crate (MIL-C-3774).

Vertical Struts and Diagonals

All vertical struts and diagonals are continuous from the lower frame member to the upper frame member. Cut the diagonal and horizontal braces to fit between the vertical struts.

End Struts or Corner Posts

The end vertical strut or corner post of the side is not less than 2 inches in thickness in order to provide sufficient nailing space when fastening the ends.

Partial Sheathing Boards

Always apply the sheathing boards vertically. These boards are located at the corners and at various intervals based upon the design of the crate.

Lumber Sheathing

The sheathing boards are of one piece material, 1 inch thick, and from 4 to 10 inches wide. All end boards ar at least 6 inches wide, preferably wider. Ten percent of the boards may be 4 inches wide, but no narrow boards may be adjacent to each other.

Plywood Sheathing

Plywood strips, three or five ply material, may be substituted for lumber sheathing in the sides, ends, or tops. This material must be the same width as the lumber sheathing. For loads up to 5,000 pounds, use 7/16 inch plywood of group I woods; 3/8 inch of group II woods; 5/16 inch of group III and IV woods. For loads over 5,000 pounds, use 1/2 inch plywood of group I woods; 7/16 inch of group II woods; 3/8 inch of group III and IV woods.

Gusset Plates

Gusset plates are required for crates using 1 inch frame members. Place the gusset plates where the diagonals, struts, or horizontal braces intersect. Plywood gusset plates are not required when plywood sheathing is used. Use 12 X 12 X 1/4 inch gusset plate for 1 X 4 inch frame members. Use 18 X 18 X 1/4 inch gusset plate for 1 X 6 inch frame members. Secure the gusset plates to frame members using sevenpenny nails and clinch (fig 6-45).

Nailing Lumber Sheathing

Nail 4 to 6 inches wide sheathing boards of horizontal and diagonal members with three rows of ninepenny clinched nails. Use three nails in sheathing boards 4 to 6 inches wide and four nails in wider boards. Nail sheathing boards over 6 inches wide to horizontal and diagonal members with four rows of ninepenny clinched nails. Nail sheathing boards 4 to 6 inches wide to vertical struts with two rows of ninepenny nails, spaced 6 inches apart in each row and clinch.

Nailing Plywood Sheathing

Nail plywood sheathing to 4 inch wide frame members with two rows of nails, spaced 6 inches apart in each row, and clinch. Use three rows in frame members over 4 inches wide. The nailing requirements are identical to those illustrated in figure 6-5 except for the spacing.

Ends

The end frame members are identical to those of the sides. The design of the end panels is also based upon the inside length and inside height of the crate. The panel design will be either X or HK framing (fig 6-45).

Member Selection

The frame members of the ends are the same size as the corresponding members of the sides.

Top Panels

The top panels consist of framing members, partial sheathing boards, gusset plates and joists. Tops are classified according to types (table 6-22 and fig 6-46).

Number of Panels

To determine the number of panels for N, X or HK type of top, divide the crate length by the crate width and use the nearest whole number.

Frame Members

All top frame members are 1 X 6 inch material. When the width of the top is 24 inches or less use 1 X 4 inch material.

Gusset Plates

Use gusset plates at the intersection of the frame members of the top. They are the same size and nailed in the same manner as those for the side and end panels.

Top Joists

Determine the size of the joists by the weight of the contents and the length of the joists (table 6-15). Space the joists not more than 48 inches center to center. Extend all joists from the upper longitudinal member of one side to the upper longitudinal member of the other side. Fasten each joist with three twelvepenny coated sinkers through the upper edge members of the side into the end of the joist when the framing is one inch thick. Use three twentypenny nails per joint for 2-inch upper frame members. This nailing is accomplished as the crate is being assembled.

FABRICATION OF OPEN NAILED CRATES

Sheathing to the Horizontal and Diagonal Frame Members

Use nails for securing the sheathing to the frame members (up to and including 2-inch thickness) long enough to permit clinching at least one-fourth of an inch. Use three rows of nails to secure the sheathing. Use a minimum of three nails in each sheathing board up to 6 inches wide. Use not less than four nails in wider boards.

Sheathing to the Vertical Frame Members

Use two rows of nails, placed on 6-inch centers, in each row and stagger (table 6-24 and figure 6-46).

Plywood Sheathing to the Frame Members

The nails for fastening plywood to framing members shall be long enough to pass through the plywood and the frame member and be clinched not less than one-fourth of an inch. Stagger all nails in two parallel rows in each frame member up to 3-5/8 inches wide, and in three rows in wider frame members. Place the nails not less than one-half of an inch from the edge of the frame members. The distance between rows of nails is not less than 1 inch, and the distance between adjacent nails in any row is not to exceed 6 inches.

Sheathing to the Side Frame Members of the Top

Use two rows of nails. One row three-fourths of an inch from the inside edge of the frame member, and one row three-fourths of an inch from the outside edge. Stagger the nails between rows with a minimum of two clinched nails in each sheathing board at each longitudinal member.

Sheathing to the End Frame Members of the Top

Place one row of nails in three-fourths of an inch from the inside edge of the frame member. Place the other row in the center of the frame members. Space the nails 9 inches apart in each row and clinch.

Sheathing to the Longitudinal and Diagonal Members of the Top

Use three rows of nails, with not less than three nails in sheathing boards 6 inches wide. Use not less than four nails in wider boards.

Sheathing to the Struts of the Top

Two rows of nails are required not less than three-fourths inch from the edges of both the frame members and the sheathing. Space the nails on 9-inch centers in each row and clinch.

Plywood Sheathing to the Frame Members of the Top

If plywood is substituted for lumber, stagger the nails in two parallel rows and space them 6 inches apart in each row. Position the nails three-fourths inch from the edge of the frame members. The nails must be long enough to penetrate both the members and be clinched at least three-fourths of an inch.

Table 6-22. Type of Tops (MIL-C-3774)

Type framing pattern	Width of top (in.)
N.....	Up to 40
X.....	Over 40 through 60
HK.....	Over 60 through 96

Table 6-23. Nailed Crate Assembly (MIL-C-3774)

Fasten		Size type of nail	Maximum spacing	Notes
Part	To part			
			Inches	
Corner strut of end - (1-inch member)	Corner of strut of the side	12d	12	
Corner strut of end - (2-in. member)	Corner strut of the side	20d	12	
Sheathing of side	Corner strut of the end	8d	6 to 8	Predrill through sheathing of end and corner strut of end.
Edge frame member of top - (through sheathing)	Upper frame member of sides	12d	6 center to center	Stagger
Edge frame member of top	Upper frame member of sides	8d	6 to 8	Space nails between top sheathing
End strut of top	Upper frame member of end	12d	6	Stagger

Table 6-24. Nailed Per Each 1,000-Pound Gross Load; Nailing Side Sheathing to Skids or Sills and End Sheathing to Headers and Sills

Nail	Wood groups of skids			
Type	Penny size	II	III	IV
Common	7	20	21	16
Sinker or cooler	7	23	26	19
Sinker or cooler	8 or 9	19	21	16
Sinker or cooler	10	18	19	14
Corker	8 or 9	17	19	14

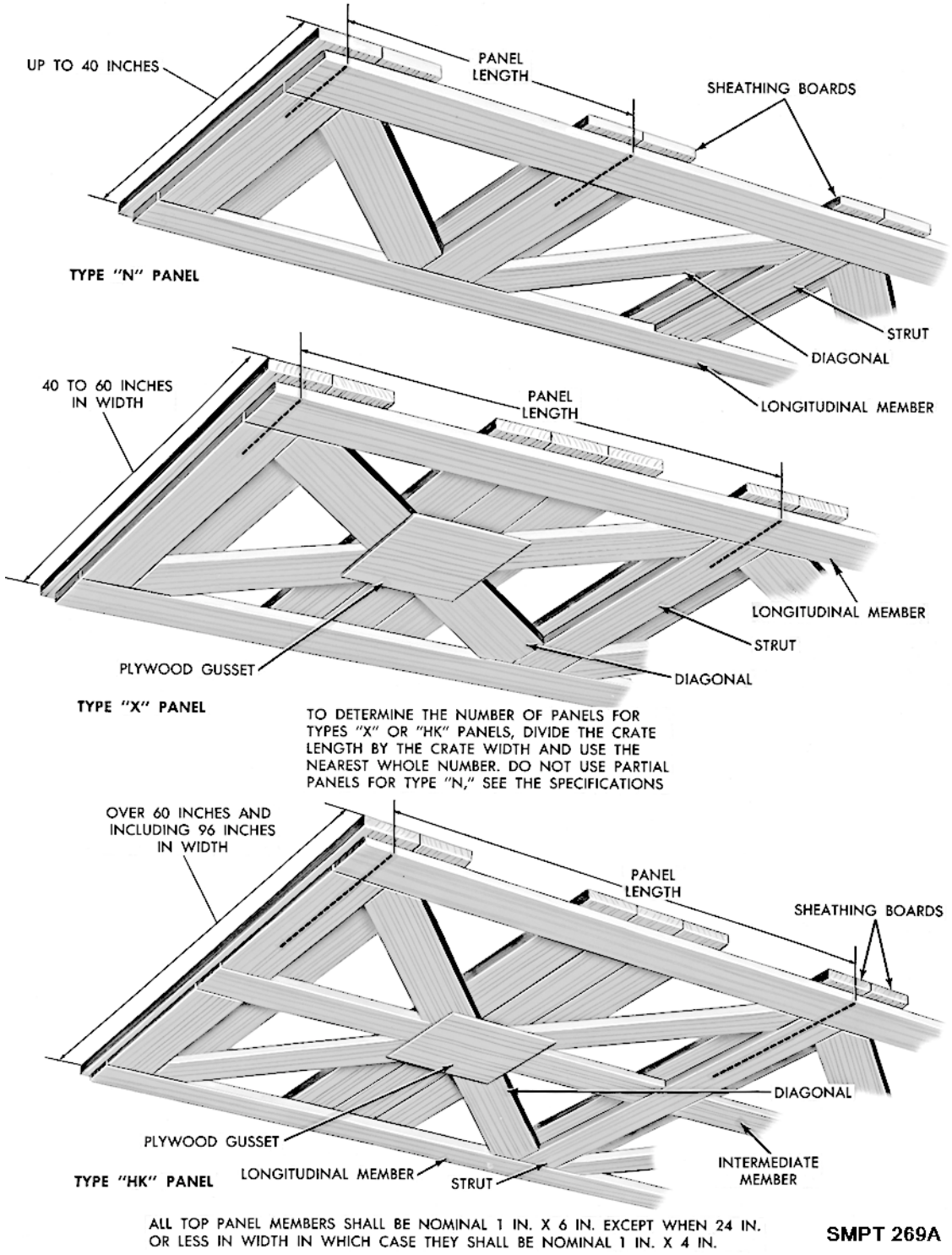


Figure 6-46. Types of top panels (MIL-C-3774).

ASSEMBLY OF OPEN NAILED CRATES (FIGS 6-4, 6-47 AND 6-48)

Nailing Requirements

The nailing requirements for fastening the base, sides, ends, and top together are found in tables 6-23 and 6-24.

Nailing Procedures

When attaching the sides and ends to the skids, use one row of nails (staggered) for 2 inch-deep skids, two rows for 3 and 4 inch-deep sills and three rows for deeper members. Secure the corner struts of the end to the corner struts of the side with twentypenny nails spaced 12 inches apart. Nail the partial sheathing of the side to the corner strut of the end using eightpenny nails, spaced 6 to 8 inches apart, and staggered. Nail through the top sheathing into the upper edge members using twelvepenny nails spaced 6 inches apart, center to center. Nail the top sheathing to the top joists using twelvepenny nails, spaced 8 inches apart.

Corner strappings (figs 6-4 and 6-18)

SHEATHED WOOD CRATES, MIL-C-104 (GENERAL)

MIL-C-104 covers requirements for two types and two classes of sheathed crates each of which may have two styles of bases. The crates are designed for net loads not exceeding 30,000 pounds and to withstand the most severe overseas shipping and storage conditions.

CLASSIFICATION

Eight crate designs are possible through the combination of the following types, classes and styles. These crates are available in different type, classes, and styles. For example a type I (nailed), class 2 (plywood sheathed), Style A (skid base) crate may be used.

Type I - Nailed
Type II - Bolted
Class 1 - Lumber sheathed
Class 2 - Plywood sheathed
Style a - Skid base
Style b - Sill base

Weight Limitations

The gross weight of these crates should not be more than 11,200 pounds whenever practical. This weight is recommended in order to permit handling with ship's gear. However, when this limitation is not possible, the gross weight may be greater than 11,200 pounds but less than 20,000 pounds for crates with Style B (sill) bases, or 30,000 pounds for crates with Style A (skid) bases.

Dimension Limitations

The exterior dimensions of the crate shall not exceed the following limitations, unless specified, for overseas shipment for which dimensions of the International Loading Gauge shall apply.

Length - 30 feet Width - 9 feet Height - 10 feet

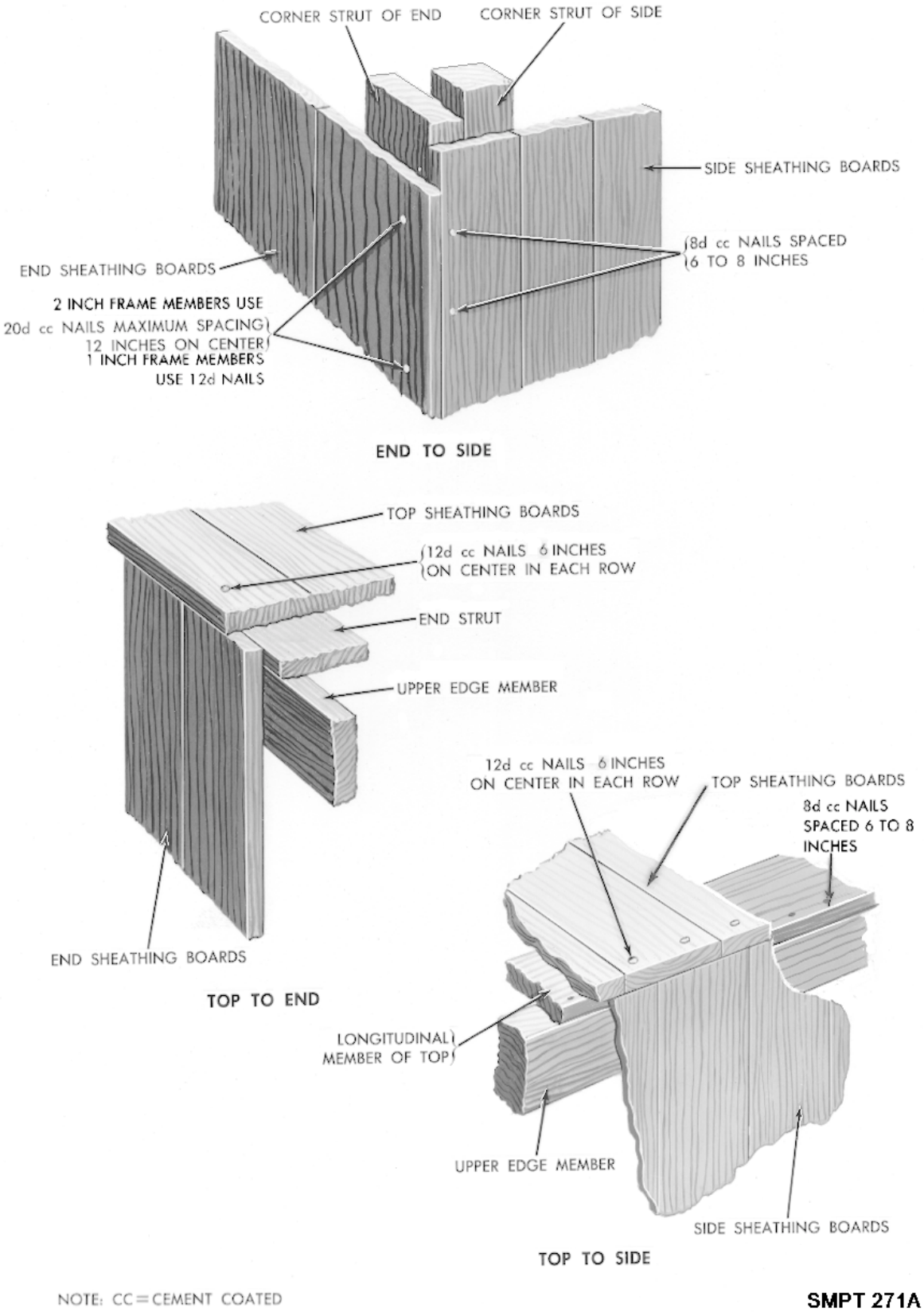


Figure 6-47. Assembly of open nailed crates (MIL-C-3774).

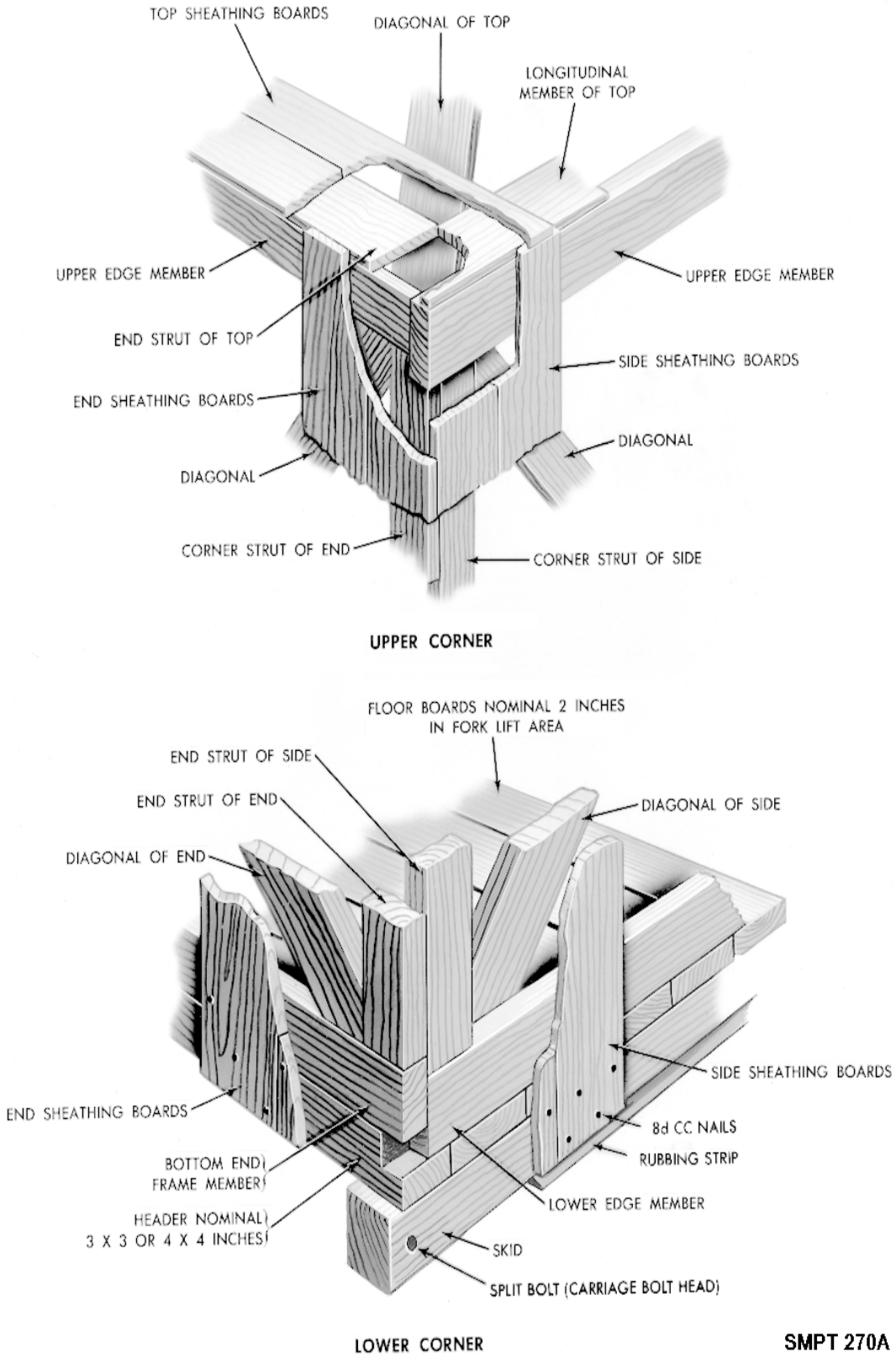


Figure 6-48. Assembly details for nailed crates (MIL-C-3774).

Interior Clearance

A clearance of not less than 1 inch shall be allowed between the item and the closest member of the sides, ends, and top of the crate. Fragile items or items within floating bag barriers shall be protected with clearances of not less than 2 inches. Additional clearances may be provided for shock mounted items. Protruding parts at the top may be allowed to extend between joists; spacing of joists may be adjusted slightly to accommodate projections.

MATERIAL REQUIREMENTS

Material

Material shall be as specified herein. Materials not specified shall be selected by the contractor and shall be subject to all provisions of MIL-C-104 specification.

Lumber

Lumber components shall conform to woods commonly used.

Plywood

Plywood shall conform to A-A-55057 Type A or B. Plywood (type A or B) shall comply with PS1 and PS2.

Nails and Staples

Nails and staples shall be steel and shall conform to ASTM F 1667-95.

Nuts, and Washers

Nuts shall conform to FF-N-836, Type I or II, style 1 or 4. Washers shall conform to FF-W-92, Type A, Grade I, Class A.

Strapping

Strapping shall conform to ASTM D 3953, Type 1 or 2 as applicable. Finish shall be A, B, or C.

Barrier Material

Barrier material, for crate liners, shall conforms to PPP-B-1055, class as appropriate for crate liners.

CONSTRUCTION

Nailing Procedure

Nails used shall be sinkers, coolers,, corkers, or common. Nails sizes specified for the fabrication of the various crates are based on Groups I and II woods. When Groups III or IV woods are used, nails sizes may be onepenny size smaller than those specified. The patterns to be used for the nailing of two flat pieces of lumber shall conform to the details shown in figure 6-50). Unless otherwise specified herein, the following requirements shall determine size, placement, and quantity of nails:

- All adjacent crate members shall be securely fastened to each other, either directly or by means of the covering.
- All nails that are not to be clinched shall be cement-coated.
- Nails shall be driven through the thinner member into the thicker member wherever possible.

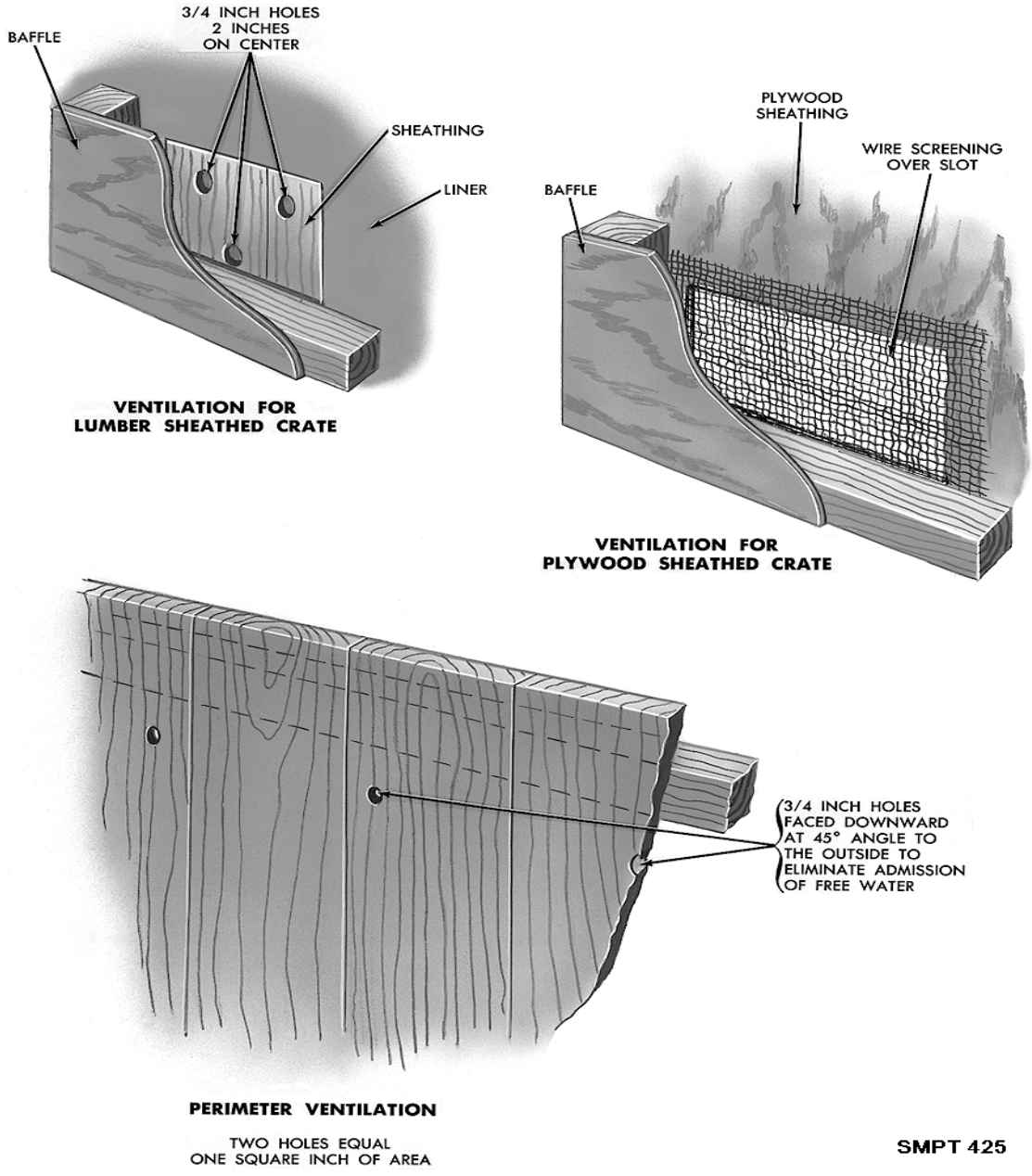


Figure 6-49. Ventilation end screening of sheathed crates.

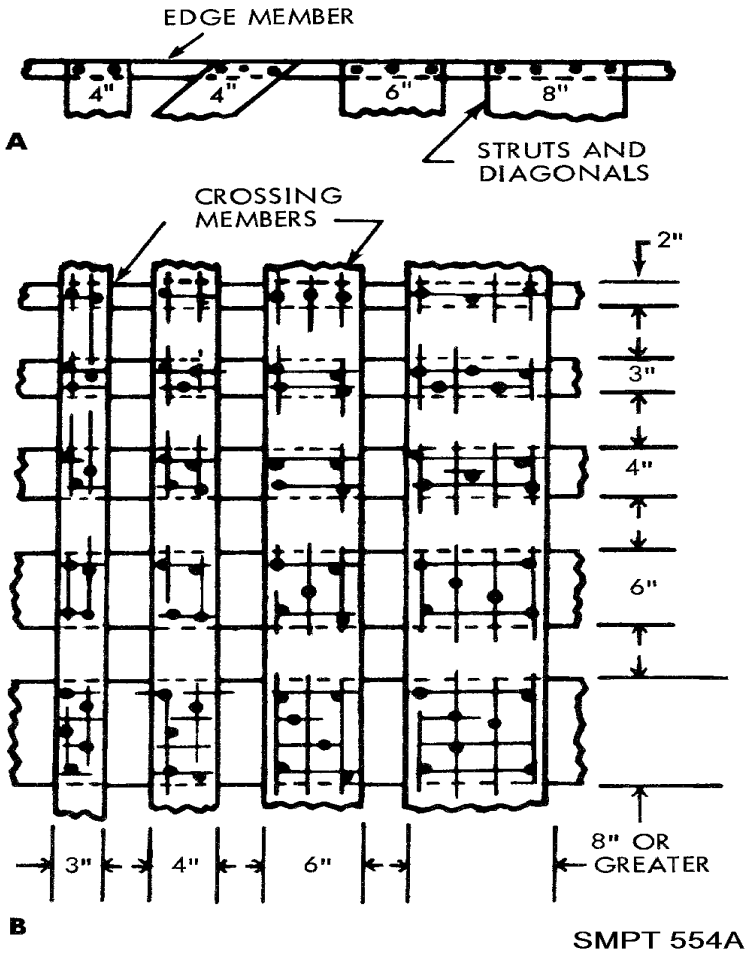


Figure 6-50. Nailing patterns.

- Nails for fastening plywood to framing shall be clinched at least 1/4 inch. Heads of nails shall always be on the plywood side.
- When the flat faces of pieces of lumber are nailed together and the combined thickness is 3 inches or less (except for top joists and covering material), nails shall be long enough to pass through both thicknesses and shall be clinched not less than 1/4 inch or more than 3/8 inch.
- When the flat faces of pieces of lumber are nailed together and the combined thickness is more than 3 inches or when the flat face of one or more pieces is nailed to the edge or end face of another, nails shall not be clinched. The portion of the nail in the thicker piece shall not be less than 2 times the length of the nail in the thinner piece for tenpenny nails and smaller, and not less than 1-1/2 inches for twelvepenny nails and larger.
- When splitting occurs with the use of diamond-point nails, the nails shall be slightly blunted. When blunting does not prevent the splitting, holes slightly smaller than the diameter of the nail shall be drilled for each nail.
- Nails shall be driven so that neither the head nor the point projects above the surface of the wood. Occasional over-driving will be permitted, but nails shall not be over-driven more than one-eighth the thickness of the piece holding the head.

- Nails shall be positioned not less than the thickness of the piece from the end and not less than one-half the thickness of the piece from the side edge of the lumber whenever possible. Nails driven into the side edge of lumber shall be centered on the side edge.
- Nails securing plywood sheathing to frame members shall be spaced as shown in figure 6-51. Machine driven nails having a definite head may be used for securing plywood sheathing providing they meet size requirements specified herein.

Stapling

Staples may be used to fasten sheathing to frame members. They shall not be used for fabrication of bases, fastening of framing members to each other, or for assembly of crates. Staples shall have crowns of not less than 3/8 inch wide and shall have a wire diameter of not less than 0.062 inch (16 gage). Straight leg staples shall be long enough to provide a minimum 1/4-inch clinch. Divergent point staples shall not be less than 1 inch long. Spacing of staples shall be the same as for nails. Staples shall always be driven from the plywood side.

Bolt Application

Holes shall be prebored to receive carriage bolts and shall be the exact diameter of the bolt. The lead holes for lag bolts shall be the same diameter as the shank, even though the threaded portion may have a greater diameter than the shank, and shall be as shown in table 6-25.

Lag bolts shall be placed by being turned in their holes the full length of the bolt and shall not be driven in with a hammer or by any similar means. If, for any reason, the thread in the wood is stripped when the lag bolts are placed, the lag bolt shall be removed and placed in a new hole near the old position. A flat washer shall be used under the head of each lag bolt and under the nut of each carriage bolt. After the nut is placed, the thread of the carriage bolt projecting beyond the nut shall be painted with a suitable metal primer or similar material.

Ventilation (figs 6-49 and 6-51)

All crates shall be provided with ventilating holes or slots which shall be located at each end or at ends and sides of lumber and plywood sheathed crates, or around the perimeter of plywood and lumber sheathed crates. These ventilating holes or slots shall be located immediately below the top frame member and be provided with a baffle as shown in figure 6-51 when slots are used in plywood sheathed crates or when holes are in clusters in lumber sheathed crates. Single holes drilled without baffles shall be sloped at 45 degrees to drain outward. No holes or slots shall be cut in any frame member.

Class 1 Crates

Class 1 crates shall be provided with ventilation holes, 3/4 inch in diameter. The crate liner shall be removed from the ventilating area and all splinters and chips shall be removed from the holes.

End Ventilation

Ventilating holes shall be provided in each end in one or more clusters, placed near the upper frame members, provided with a baffle, and spaced 2 inches on center as shown in figure 6-51. In small crates, holes may be located so that diagonals or struts can be utilized in part for cleats. In crates over 10 feet in length, the ventilating holes shall be divided equally between

the sides and ends with a baffle provided for each group of holes. The clusters of holes shall be located as near the midpoint of the side and end as practical. The number of holes shall comply with table 6-26.

Perimeter Ventilation

As an alternate to end ventilation, the 3/4 inch ventilating holes may be spaced evenly around the perimeter of the crate just under the top frame member and drilled at a 45 degree angle to drain outward (fig 6-49). The total number of holes shall comply with table 6-26.

Table 6-25. Lag bolt lead hole sizes.

Diameter of Threaded Portion of Lag Bolt (inch)	Diameter of Lead Hole (inch)	
	Groups I, II, and III Woods	Group IV Woods
1/4	3/16	3/16
5/16	1/4	1/4
3/8	1/4	5/16
1/2	3/8	7/16
5/8	3/8	1/2
3/4	1/2	5/8

Table 6-26. Ventilation holes and area required.

Lumber-sheathed crates			Plywood-sheathed crates
Volume of crate (cu. ft.)	End ventilation minimum number of 3/4 inch diameter holes required in each end (place in cluster and use baffle)	Perimeter ventilation (alternate) Total minimum number of 3/4 inch diameter holes required around perimeter (space evenly and slope to drain out)	Area required in each end (Use baffle and screen) (sq. in.)
0-100	3	6	7
100-150	4	8	10
150-200	5	10	14
200-400	9	18	27
400-600	14	27	40
600-800	18	36	52
800-1,000	22	44	66
1,000-1,200	27	54	80
1,200 and over	33	66	100

Note. In large crates, where a large ventilating area is required, two or more slots or clusters of holes may be used in each panel.

Class 2 Crates

Class 2 crates shall be provided with a horizontal slot in each end. The ventilation slots shall be provided with baffles and screens as shown in figure 6-51. The required ventilating area shall comply with table 6-26. In crates over 10 feet in length, the ventilation area shall be divided equally between the sides and ends of the crate with baffle and screen provided for each ventilating area. The ventilating area shall be placed as near the midpoints of the sides and ends as practical. In small crates, 3/4 inch diameter holes may be substituted for the slots in the proportion of two holes for each square inch of required area.

Class 1 Crates

Class 1 crates may be either bolted or nailed. Bolted crates shall be so designed that the major components of base, sides, ends, and top may be assembled to each other with lag bolts in order that the crate can be readily disassembled and, if desired, reassembled without major damage to the parts. Nailed crates are assembled with nails and straps, are not easily demountable, and because of probable damage during disassembly, are not generally reused. A combination of top, side, and end panels may be fabricated and assembled to each other as specified for nailed crates, and the unit fastened to the base as specified for bolted crates.

Bases

Bases shall be designed to support the weight of the crated article only when the sides and ends are fastened in place.

Skid Type (Style a)

Style a bases shall consist of longitudinal skids and rubbing strips, headers, load-bearing floorboards, and flooring as shown on figures 6-52 and 6-53. Details of construction shall be the same for bolted and nailed crates.

Table 6-27. Allowable minimum skid sizes

Maximum netload (lb.)	Maximum length of crate (ft.)	Nominal size of skids (in.)
300	16	2 X 4 (flat) 1/
1,000	12	2 X 4 (flat) 1/
2,000	20	3 X 3 or 3 X 4 (flat) 2/
10,000	32	4 X 4
30,000	20	4 X 6 (on edge)

1/ For nailed crates only.
2/ For crates with 2-inch-thick lower frame member or 2-inch end struts.

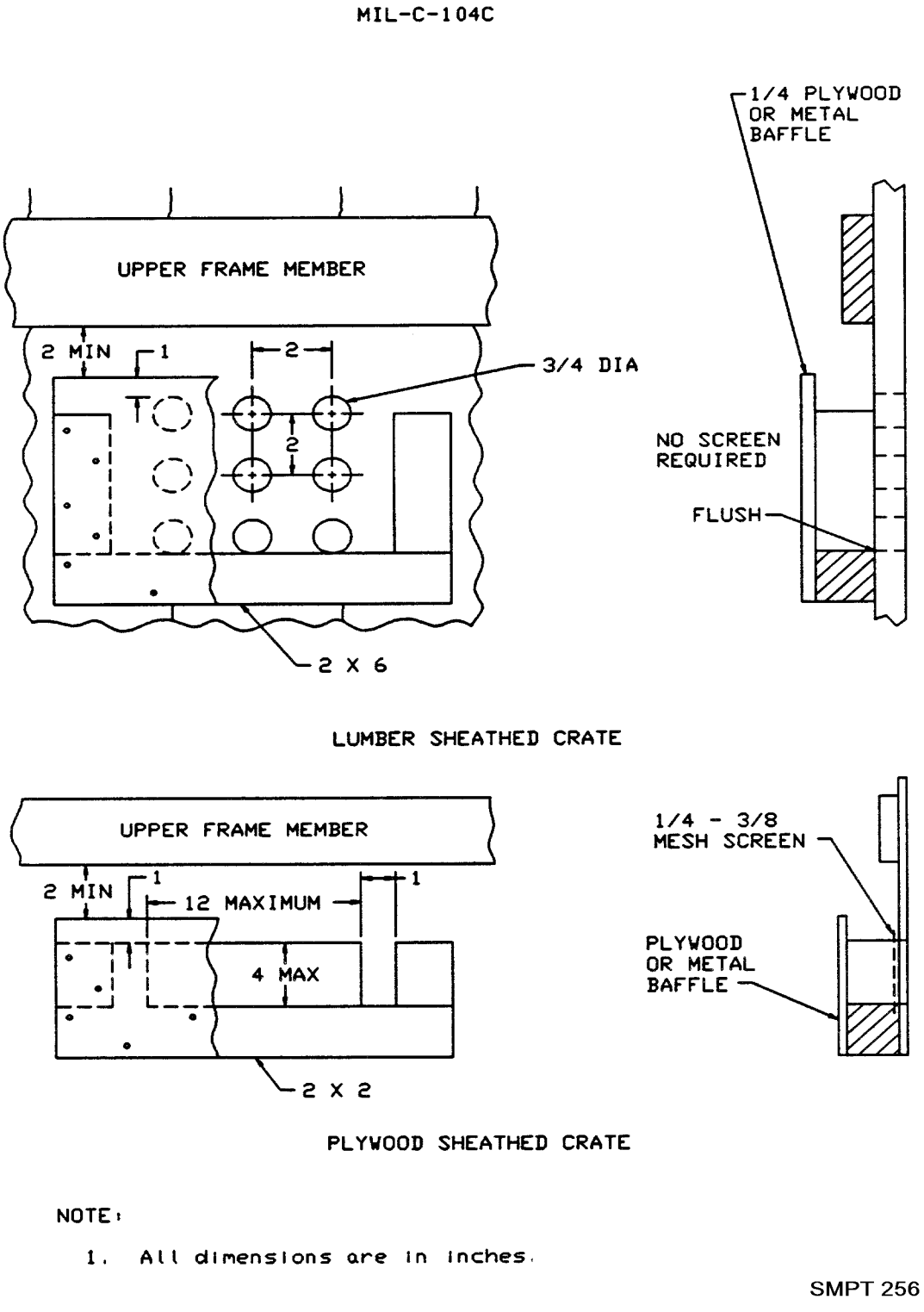
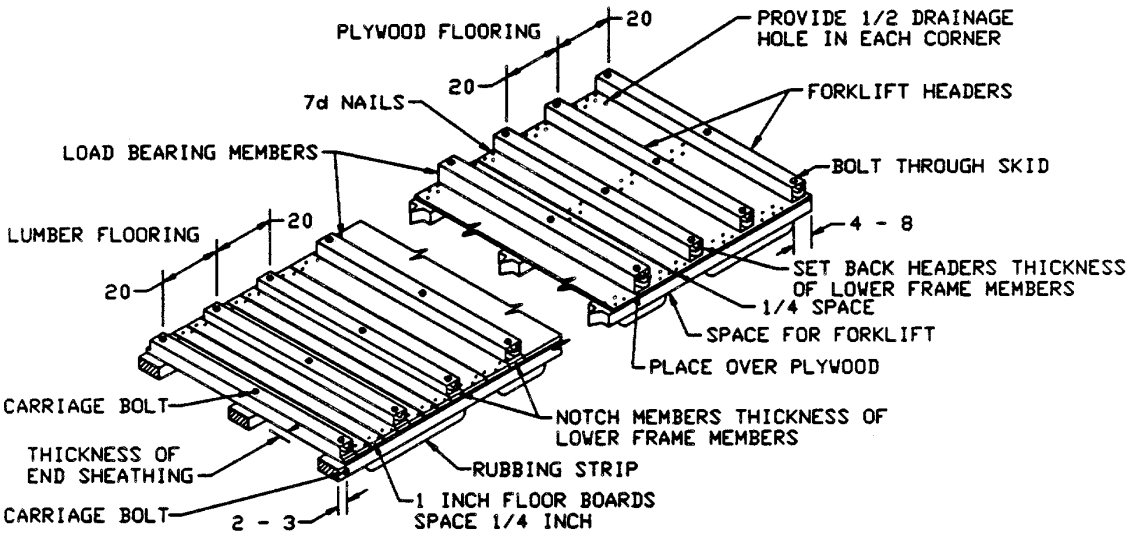
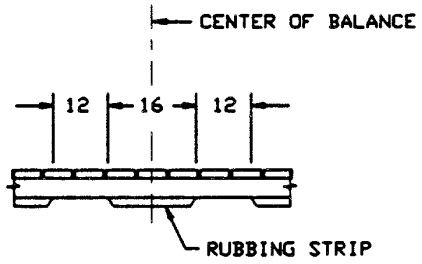


Figure 6-51. Ventilation of lumber and plywood sheathed crates (MIL-C-104).

MIL-C-104C





FORKLIFT AREA

Note:

1. All dimensions are in inches.

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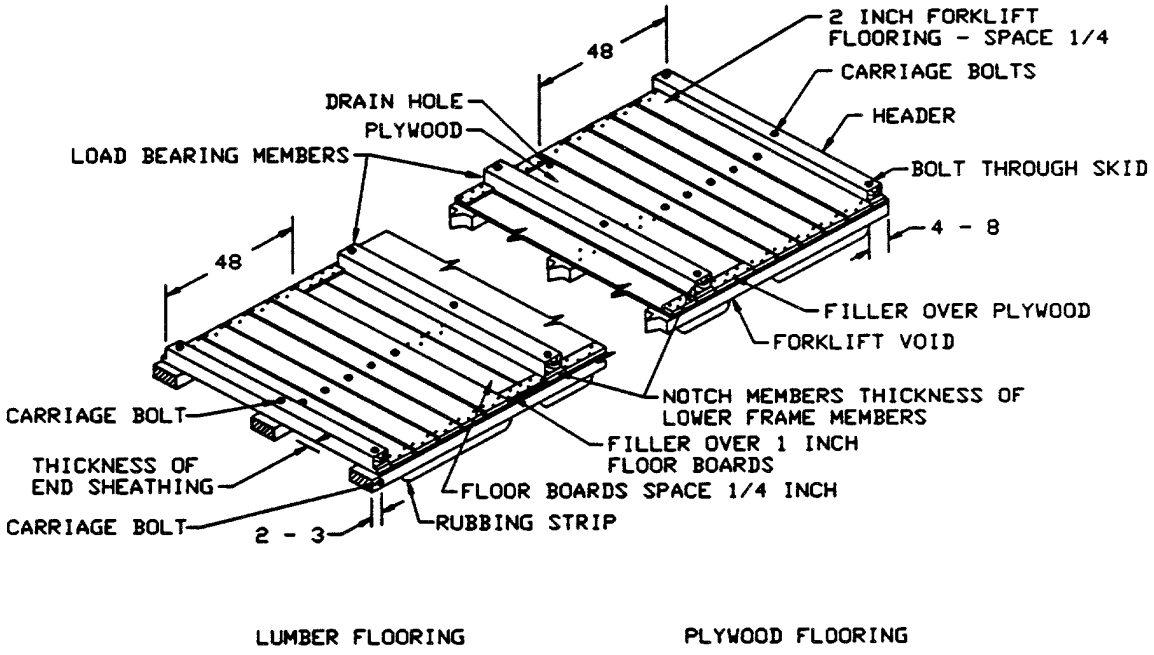
Figure 6-52. Skid base plywood flooring (MIL-C-104).

MIL-C-104C



Note:

1. All dimensions are in inches.

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Figure 6-53. Skid base lumber flooring (MIL-C-104).

Skids

Any species of wood except Groups I shall be used for skids. Skids shall be spaced no farther apart than 48 inches, center to center, across the width of the base. Minimum size shall be as shown in table 6-27. When either the length or net load exceed the maximum shown, the next larger skid shall be used.

When necessary, skids may be spliced or laminated according to the details shown in figures 6-54 and 6-55, but the use of 2 x 4 inch skids shall be limited to such lengths that no splicing would be required. Whenever possible splices shall be made not more than one-third of the length of the base from the ends of the skid and the splice locations alternated in adjacent skids. To prevent splitting, all skids shall have a carriage bolt placed crosswise and 2 to 3 inches back from each end of the skid as shown in figure 6-55. Bolt sizes shall comply with table 6-28.

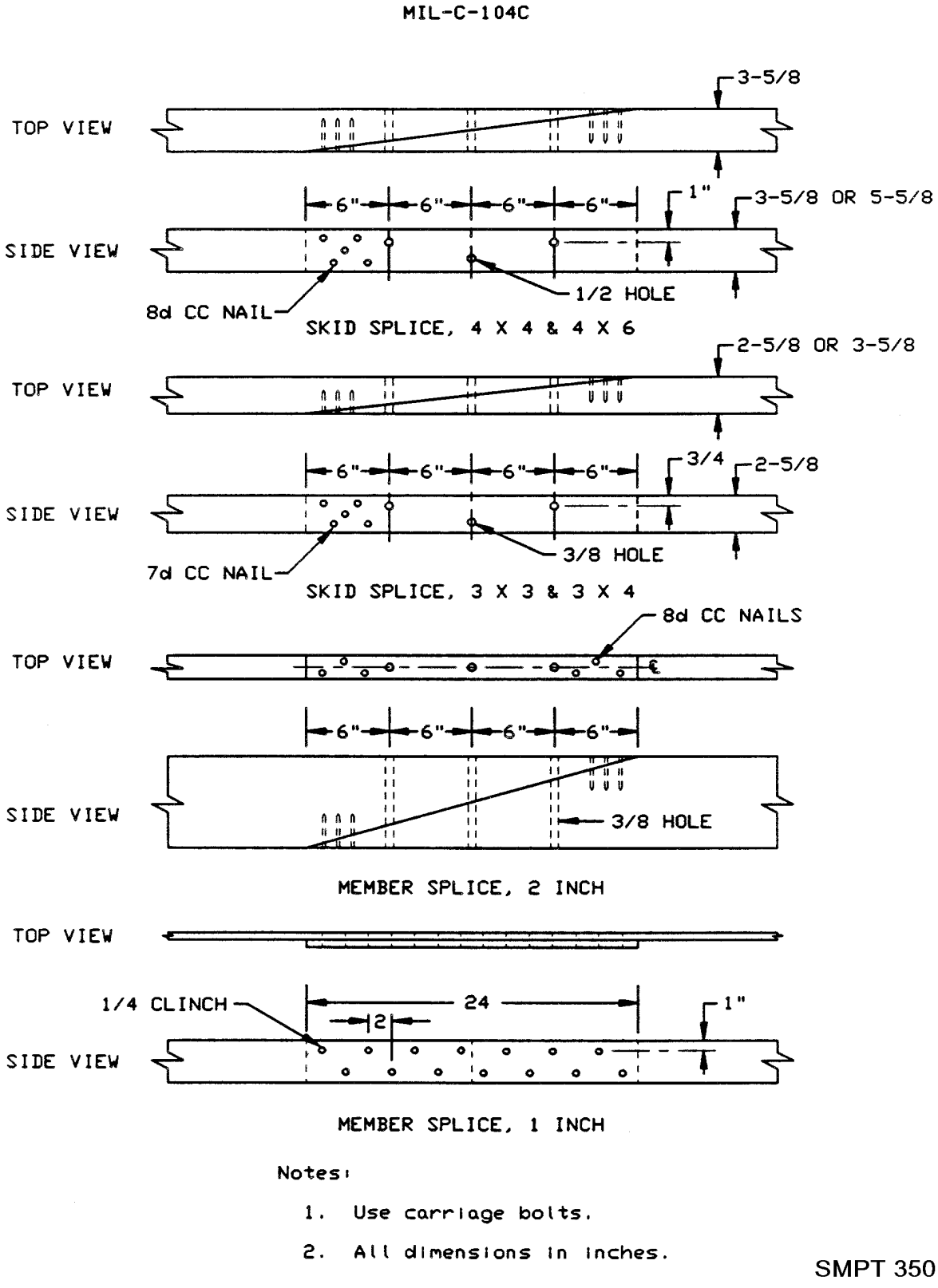
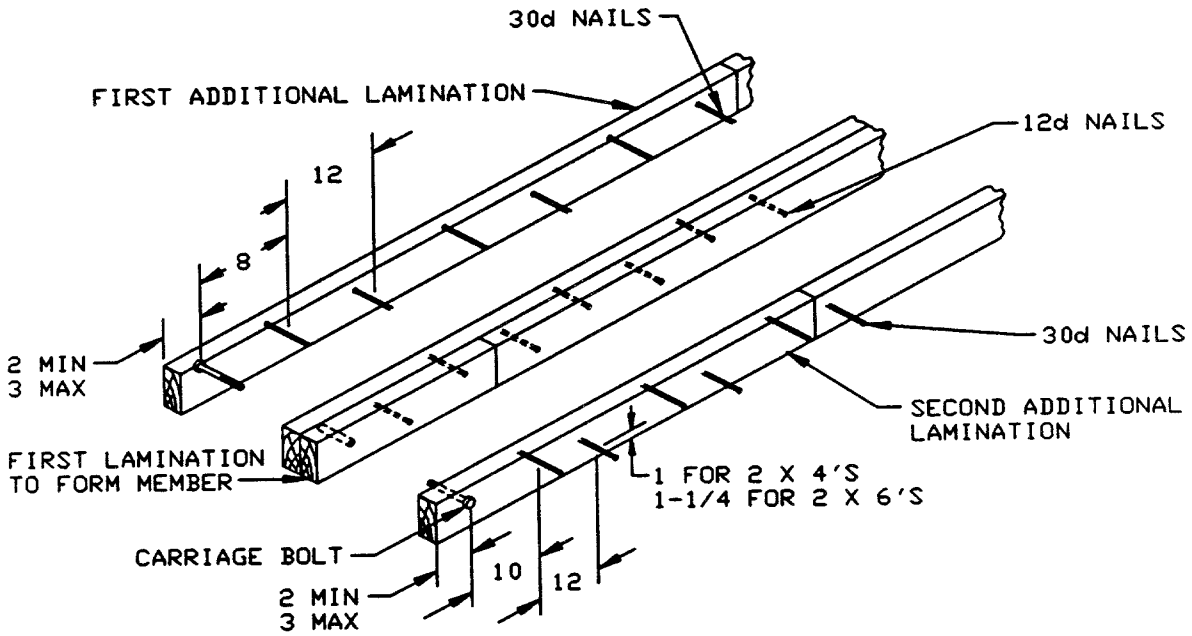
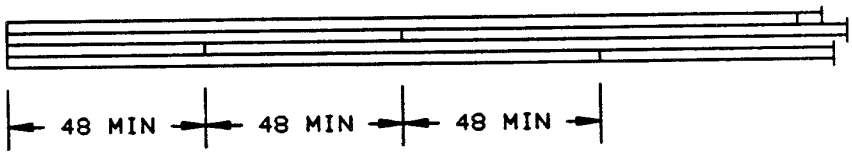


Figure 6-54. Splicing of members (MIL-C-104).

MIL-C-104C





STAGGERING JOINTS TOP VIEW

LAMINATION OF SKID OR SILL MEMBERS
(2 INCH THICK MATERIAL)

Note:

1. All dimensions in inches.

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Figure 6-55. Lamination of skid or sill members (MIL-C-104).

Table 6-28. Required header sizes and carriage bolt sizes

Skid size (in.)	Header size (in.)	Bolt Diameter (in.)
2 X 4	2 X 4 1/	3 8
3 X 3	3 X 3	3/8
3 X 4		
4 X 4	4 X 4	1/2
4 X 6		

1/ For nailed crates only in width to 48 inches. For wider crates or bolted crates, use 3X3.

Rubbing Strip for Skids

Rubbing strips of 3-inch thick lumber, the same width as the skids, shall be attached to the skids with two staggered rows of nails spaced 12 inches apart in each row The nails shall be driven through the rubbing strip into the skid, shall be of such length as to penetrate a minimum of approximately 70 percent of the skid thickness, and shall not protrude through the skid. The strips shall be beveled full depth at an angle of 45 degrees at sling and forklift openings. Openings in the rubbing strips for forklift-truck access shall be 12 inches in length, 28 inches center to center, and positioned to straddle the center of balance of the loaded crate. Sling openings not less than 4 inches in length, and preferably 8 inches, shall be provided at the ends of the rubbing strip where permitted by the length of the crate and by the location of the forklift-truck access openings. No center pieces of the rubbing stirps shall be less than 16 inches in length. On crates 5 feet and less in length, the forklift openings shall be omitted; end sling openings shall not be less than 6 inches long and shall serve as both forklift and sling openings.

Headers

Headers shall be placed at each end of the base and shall be bolted to each skid with one carriage bolt. Sizes of headers and bolts shall be as shown in table 6-28.

Forklift Members

The forklift members shall consist of the header and two members of equal size, spaced 20 to 40 inches (on center) from each end of the skids and bolted as shown in figure 6-52. Where the form of the item to be crated makes it impractical to use these members, or when crates are short or narrow, 2 inch-thick lumber shall be used in the 48-inch end areas as shown in figure 6-52. When 2-inch lumber is used in the forklift area and intermediate skids are required because of the width of the base, the 2-inch forklift members shall be bolted to the intermediate skids. Forklift members shall be notched or set back a specified for headers. If loaded containers center of balance is other than the center of the base, the space for forklift entry shall be positioned so that the center of balance is centered in between forklift openings.

Headers shall be of a single piece and not built up to two or more pieces to meet the dimension requirements. Headers shall be placed atop the plywood when plywood flooring is used. Headers shall be placed a distance back from the ends of the skids equal to the thickness of the end sheathing. The ends of the headers shall be notched for bases floored with lumber; ends of headers for plywood floored bases shall be set back from the outside edges of the outer skids (see figures 6-52 and 6-53). The notched and set back distances shall be equal to the thickness of the lower frame members of the skids.

Load-bearing Floorboards

Load-bearing floorboards shall be placed where the concentrated loads of the contents occur. The cross section shall be determined from table 6-29. The forklift members and any 1 or 2 inch flooring may be considered as load-bearing within limits of their assigned values. The ends of load-bearing floorboards shall be notched or set back from the edge of the base in the same manner as described for headers (see figures 6-52 and 6-53). Load-bearing floorboards 4 inches wide shall be bolted to each skid with one carriage bolt, and load-bearing floorboards over 4 inches wide shall be bolted to each skid with two carriage bolts, and the intermediate skid where one is required. Bolt diameters shall be the same as specified for corresponding skid sizes.

Lumber Flooring

Lumber floorboards shall be neither less than 1 inch thick not less than 4 inches wide, and shall be placed at right angles to the skids. Boards shall be spaced 1/4 inch apart for drainage and the ends placed flush with the outside face of the skids. When a large area of the base is floored with 2-inch thick lumber, the use of filler strips 2 inches wide shall be used along each side over he thinner flooring to equal the thickness of the 2 inch flooring as shown in figure 6-53. The filler strips shall be nailed to the flooring with two staggered rows of sixpenny nails spaced 10 inches apart. Nailing of floorboards to skids shall be as shown on figure 6-50.

Plywood Flooring

Plywood 3/8 inch in thickness, may be used in place of 1 inch lumber flooring as shown in figures 6-52 and 6-53, but not as load-bearing floorboards. Plywood flooring shall be laid flush with the outer edges of the skids and with the face grain perpendicular to the skid length. Headers and load-bearing floorboards shall be placed on top of the plywood and bolted to the skids after the plywood has been nailed in place. Plywood flooring shall be nailed to each skid with two rows of sevenpenny nails, staggered and spaced 6 inches apart in each row. A spacing of 1/4 inch shall be allowed between sheets of plywood for drainage. When 1/3 to 1/2 the area of the base is floored with 2 inch boards, the plywood flooring shall be used only between these areas. Filler strips shall be nailed over the plywood as shown on figure 6-51 with nailing as specified.

Drainage

A drainage hole, 1/2 inch in diameter, shall be drilled next to each header or load-bearing member in each outer edge of plywood floored section of the base. Holes should not be covered with contents are placed on the base of the crate.

Sill Type (Style b)

Style b bases shall be constructed as shown in figure 6-56. The load contained on Style b bases shall always be transmitted to the side sills by means of intermediate sills or by the article itself.

Side and End Sills

The size of the side sills shall be determined from table 6-30. End sills shall be of the same size as side sills. The side sills shall overlap the end sills as shown in figure 6-56. Sills shall be laminated as shown in figure 6-55, when necessary.

Intermediate Sills and Load-bearing Headers

Intermediate sills shall be applied crosswise of the base. The size of intermediate sills shall be determined from table 6-31. The weight used to determine the size of an intermediate sill shall be that amount of the load actually supported by that sill. Load-bearing headers shall be of the same size as intermediate sills. Load-bearing headers and intermediate sills will not be required when all of the load is supported by the side sills. Load-bearing headers shall be attached at their ends to intermediate sills and intermediate sills shall be attached at their ends to side sills by a combination of nailing and the use of metal strap hangers fabricated from 1-1/4 inches wide by 0.035 inch thick nail-on strapping as shown in figure 6-57.

Bridging

Intermediate sills shall be bridged at the ends with 1-inch lumber and at intervals along the span not exceeding 4 feet with 2-inch lumber of the same depth as the intermediate sills (see figure 6-56).

Table 6-29. Allowable load in lb per inch of floorboard width groups I and II woods

Distance between skids (in.)	Thickness of load-bearing floorboard (in.)					
	3/4	1-1/2	2-2/2	3-1/2	5-1/2	7-1/2
12	57	287	600	1170	2900	5000
18	38	191	400	780	1930	3350
24	29	143	300	590	1400	2500
30	23	115	240	470	1160	2000
36	19	95	200	390	960	1680
42	16	82	170	335	830	1440
48	14	71	150	290	720	1250
54	12	63	030	260	645	1120
60	11	57	120	234	580	1000
66	10	52	110	212	525	910
72	9	48	100	195	480	840
84	8	41	85	140	360	710
96	8	35	75	167	300	630
108	7	34	66	130	233	560
120	7	30	60	117	210	500

Table 6-30. Nominal size of side sills (in.)*

Gross weight of crate (lb.)	Length of crate (ft.)							
	4	8	12	16	20	24	28	32
to 2,000	2 X 4	2 X 4	2 X 4	2 X 4	2 X 4	2 X 6	2 X 6	2 X 6
2,001 - 4,000	2 X 4	2 X 4	2 X 4	2 X 4	2 X 6	2 X 6	2 X 6	2 X 8
4,001 - 6,000	2 X 4	2 X 4	2 X 4	2 X 6	2 X 6	2 X 6	2 X 8	2 X 8
6,001 - 8,000	.....	2 X 4	2 X 6	2 X 6	2 X 6	2 X 8	2 X 8	2 X 8
8,001 - 10,000	.....	2 X 6	2 X 6	2 X 6	2 X 6	2 X 8	2 X 8	2 X 10
10,001 - 12,000	.....	2 X 6	2 X 6	2 X 8	2 X 8	2 X 8	2 X 10	2 X 10
12,001 - 14,000	.....	2 X 6	2 X 8	2 X 8	2 X 8	2 X 10	2 X 10	2 X 10
14,001 - 16,000	.....	2 X 8	2 X 8	2 X 8	2 X 10	2 X 10	2 X 10	2 X 8
16,001 - 18,000	.....	2 X 8	2 X 8	2 X 10	2 X 10	2 X 10	2-2 X 8	2-2 X 8
18,001 - 20,000	.....	2 X 8	2 X 10	2 X 10	2 X 10	2-2 X 8	2-2 X 8	2-2 X 8

* The above sizes are for crates with a height of 3 feet or less. For heights of over 3 feet, increase 2X4 sizes to 2X6; increase 2X6 to 2X8; increase 2X8 to 2X10; and increase 2- 2X8 to 2- 2X10.

Table 6-31 Allowable load for intermediate sills (in lb per inch of sill width)

Length of sill (ft)	Sill depth (inch) Groups I and II woods						
	1-1/2	2-1/2	3-1/2	5-1/2	7-1/2	9-1/2	11-1/2
4	71	150	290	720	1,250	2,000	3,000
5	57	120	234	580	1,000	1,640	2,400
6	48	100	195	480	840	1,320	2,020
7	41	85	167	399	710	1,170	1,730
8	35	75	140	350	630	1,020	1,500
9	34	66	130	300	560	910	1,350
10	30	60	117	270	500	820	1,200

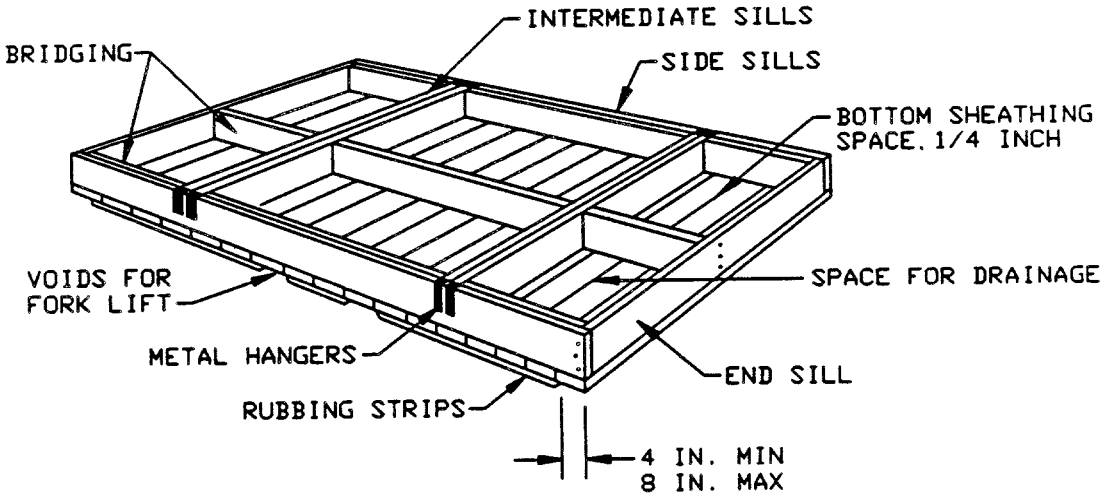
Bottom Sheathing

Style b bases shall be sheathed on the bottom with lumber securely nailed to the bottom surface of the sills at right angles to the direction of the side sills. Boards shall be 4 to 10 inches wide and of not less than 1 inch material for spans of less than 30 inches between longitudinal members and of not less than 2-inch material for spans of 30 inches or more. Bottom sheathing shall be flush with the outside face of all side and end sills and be spaced 1/4 inch apart fro drainage. One-inch boards shall be nailed with eightpenny nails, 2 inch boards with twelvepenny nails, and nailing shall be as shown in figure 6-50.

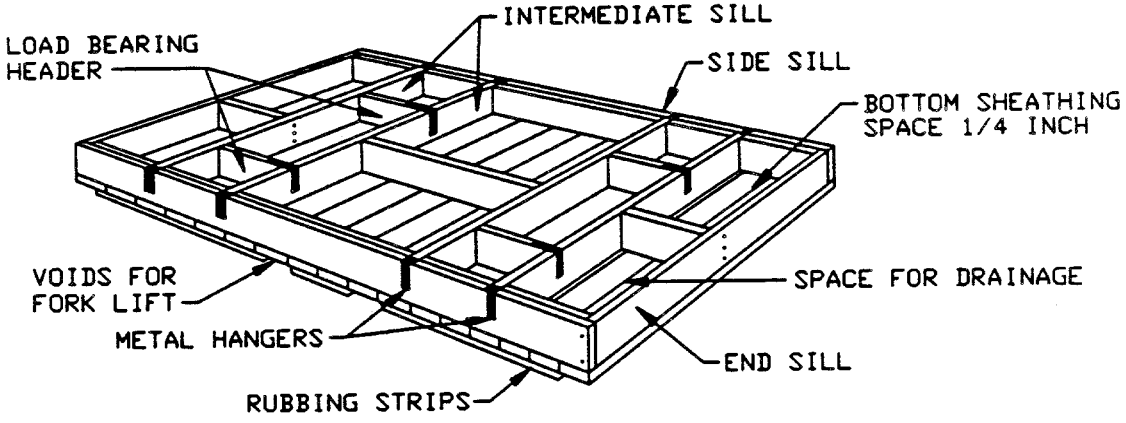
Rubbing strips

Style b bases shall have rubbing strips 3 inch thick material, the width of which shall not be less than 4 inches. The rubbing strips shall always be applied lengthwise of the base and positioned under each longitudinal member. When require, intermediate rubbing strips of the same size are located so that the clear distance between rubbing strips does not exceed 36 inches.

MIL-C-104C



SILL BASE WITH DOUBLED SILLS



SILL BASE WITH LOAD-BEARING HEADERS

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Figure 6-56. Sill bases (MIL-C-104).

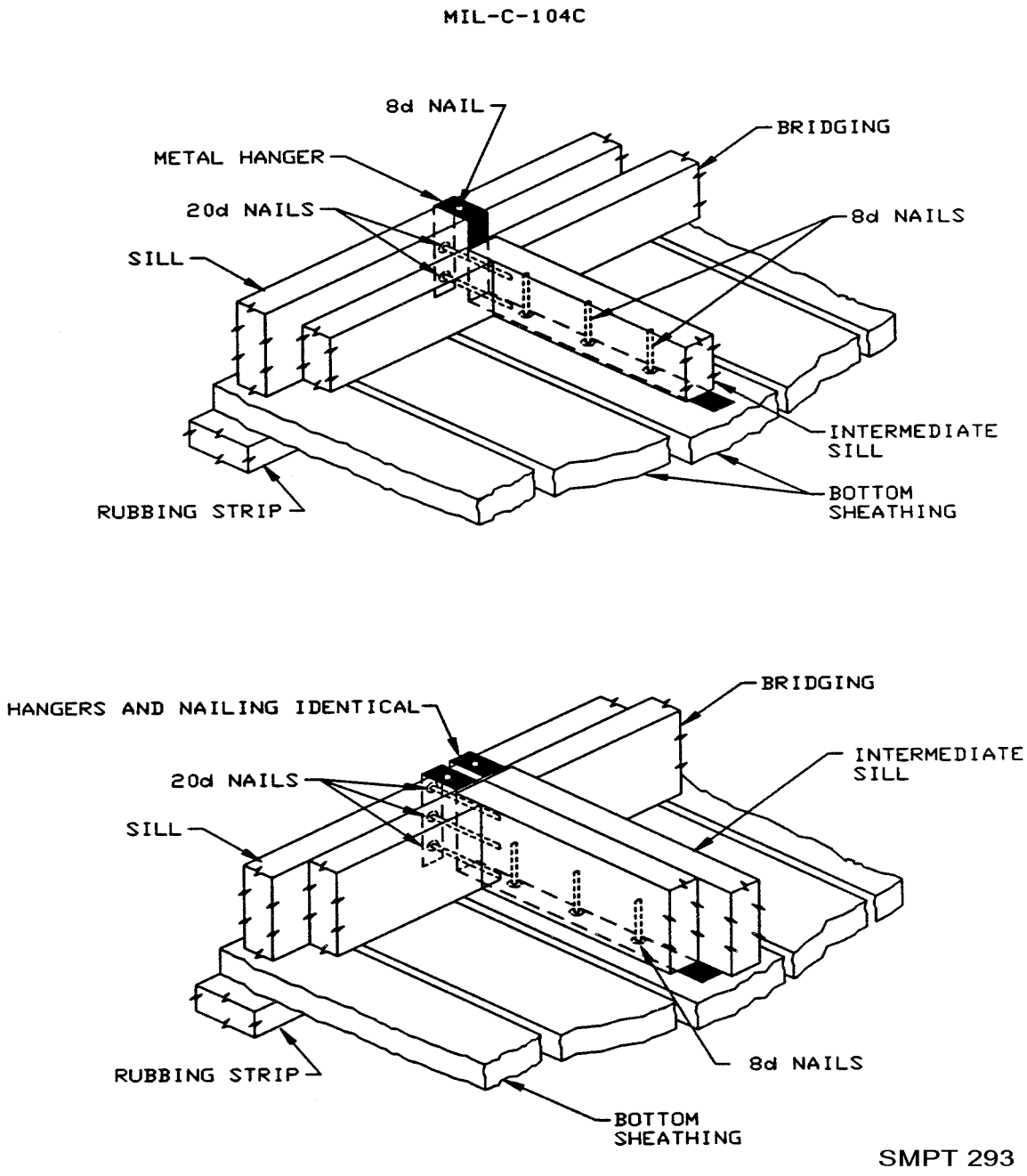


Figure 6-57. Attaching intermediate sills to side sills (MIL-C-104).

Tops

Tops shall be double sheathed and shall be

- narrow, widths through 54 inches;
- intermediate, widths over 54 inches through 60 inches;
- wide, over 60 through 120 inches in width.

Plywood sheathing 1/4 inch thick, shall be attached to the lumber framing with its face grain parallel with the width of the top and its edges flush with the outside edges of the framing. All joints of the plywood sheathing shall be made over joists or other frame members. Roofing felt, or polyethylene film

not less than 4 mils thick, shall be applied over the plywood with a minimum 4-inch overlap at joints. A nonhardening caulk or mastic shall be applied in the overlap area. Top sheathing boards not less than 4 inches wide shall be placed over the plywood sheathing and waterproof barrier and shall extend beyond the outer edges of the top framing by an amount equal to the thickness of side and end panel sheathing less 1/8 inch. Headers joining the joists together shall be 1 inch thick by the depth of the joists for intermediate and wide tops.

Narrow Tops

Narrow tops shall be framed on 2 X 4 inch members as shown in figure 6-58. Top sheathing board shall be applied parallel to the width of the top and shall be of single pieces. At plywood joints on the inside of the top, 2 X 3 inch pieces shall be used as shown in figure 6-58.

Intermediate Tops

Intermediate tops shall be framed on 2-inch joists placed flat and headers 1 inch by the thickness of the joists. The top sheathing boards shall be placed parallel to the length of the top (see figure 6-59). When the crate length is over 10 feet, end joints will be permitted in top sheathing board. All joints shall be made over joists, two joints shall be adjacent to each other, and not more than one-third of the joints shall be made over any one joist.

Wide Tops

Wide tops shall be constructed similar to intermediate tops except that the wide tops shall be framed in joists and headers placed on edge as shown in figure 6-60.

Fabrication Nailing

Fabrication nailing of tops shall be as shown in figures 6-61 and 6-62. All plywood members shall be nailed on at least three edges.

Alternate Plywood Sheathed Top

For tops not exceeding 96 inches wide, single sheathing of 1/2-inch thick plywood may be used in lieu of the double sheathed top. Face grain of the plywood shall be parallel with the width of the top. When joists do not coincide with plywood joints, a joint cover of 1 X 4 inch lumber shall be used on the inside of the top. Prior to securing the plywood to the joists or joint covers, caulking of a nonhardening type shall be applied at three places at each joint - between the plywood panels at their butt joint, and between the plywood and joint cover or joist on either side of the butt joint. The caulk shall be applied as a continuous bead and may be either performed or applied with a gun.

Sides

Number and Type of Panels

Sides shall be constructed as shown in figures 6-63, 6-64, and 6-65. In crates with style b bases, the sheathing of sides and ends shall reach below the lower horizontal frame member a distance equal to the depth of the sills plus floor thickness, less 1/8 inch. The type of side panels shall vary with the inside crate height as specified in table 6-32. The number of panels for each full length side shall be computed by dividing the inside crate length by the inside height, and using the nearest whole number.

Member Selection

The sizes of the upper and lower frame members, struts, and diagonals shall be determined from tables 6-34 to 6-43 except as otherwise specified. Loads referred to in the tables are the net loads and the dimensions are the inside measurements of the crate. The member sizes shall be based on Group II woods. If the exact size of the crate is not given in the tables, member sizes for the crate of the next greater length and width, and the next smaller height shall be used.

Upper and Lower Frame Members

Except where vertical joist supports are required, upper frame members for crates over 54 inches wide shall always be 2 inches thick and a minimum of 2 X 4 inches in size. Splicing of upper or lower frame members shall be done over or under a strut and shall be as shown in figure 6-64.

Vertical Struts

Vertical struts shall be continuous from the lower frame member to the upper frame member and the diagonal and horizontal braces shall be cut in between. The end struts shall be as shown in table 6-33.

Horizontal braces

Horizontal braces for Types B and C panels (figures 6-64 and 6-65) shall be the same thickness as the struts and 4 inches wide.

Diagonals

Size of diagonals shall be as specified in the member selection tables 6-34 to 6-43 and shall be located as shown in figures 6-63, 6-64 and 6-65. When frame members are 1 inch thick, gusset plates shall be cut from 1/4-inch plywood and shall be 12 inches minimum, in the shortest dimension. The corners shall coincide with the center line of the diagonals as shown in figure 6-65.

Joist Supports

The upper frame members shall serve as supports for tops. When crates are 6 feet wide and 12 feet high or 8 feet wide and 10 feet high (tables 6-34 to 6-43) and when the struts are 1 inch thick, vertical joist supports shall be provided as shown in figure 6-66. These shall consist of 2 by 4 inch members placed on and nailed to the frame members of the side and extending under each interior joist to the floor.

Table 6-32. Side panel types - class 1 crates

Inside height of crate (in.)	Type of panel	Reference figure No.
Over 24 to 60	A	13
Over 60 to 108	B	14
Over 108 to 144	C	15

Table 6-33. End strut requirements

Net load (lb.)	Nominal size of end struts	
	Bolted crate (in.)	Nailed crate (in.)
1,000 or under	2 X 4	2 X 4
Over 1,000 but under 5,000	3 X 3	2 X 4
5,000 and over	4 X 4	2 X 4

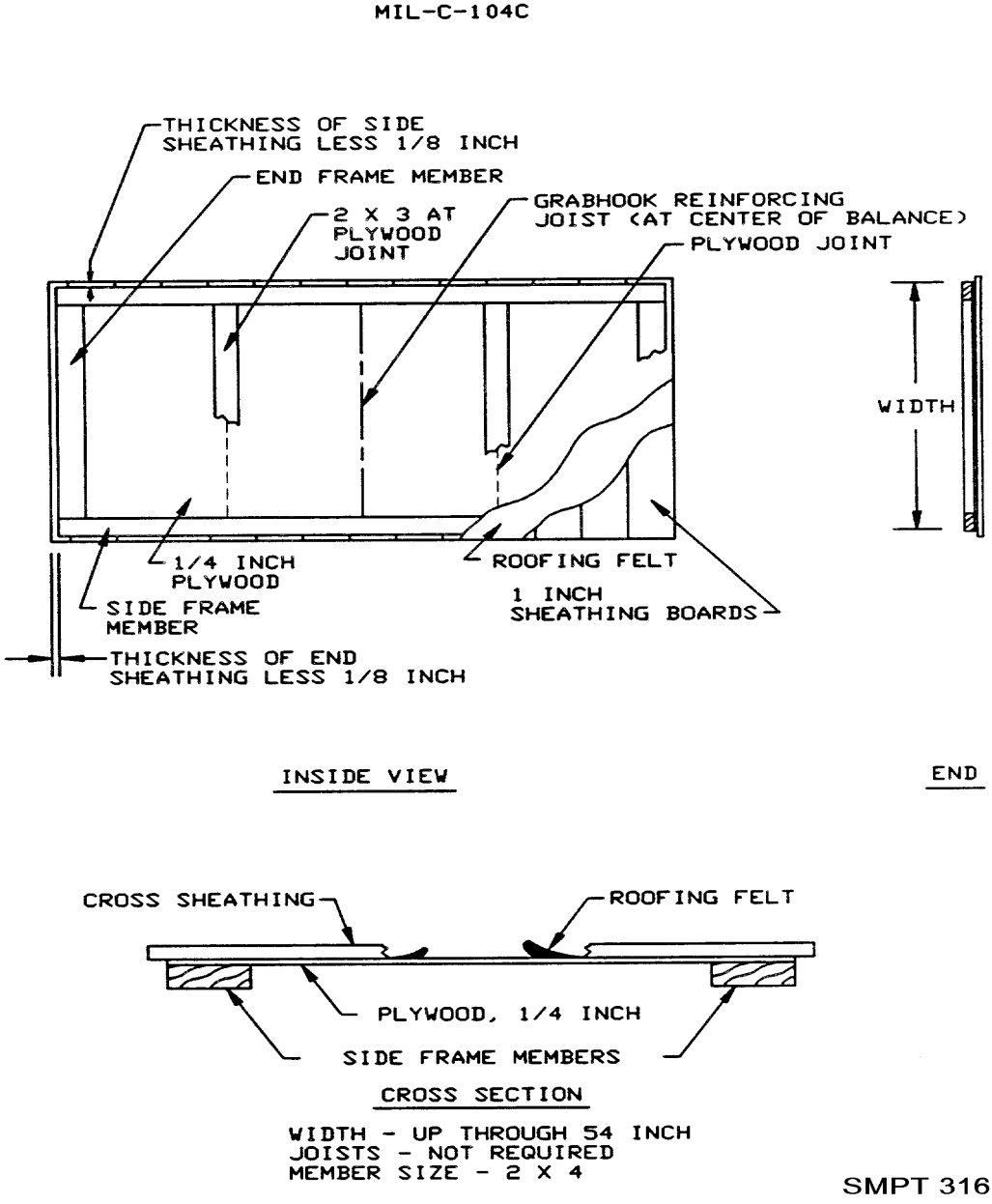


Figure 6-58. Narrow tops (widths up to 54 inches) (MIL-C-104).

MIL-C-104C

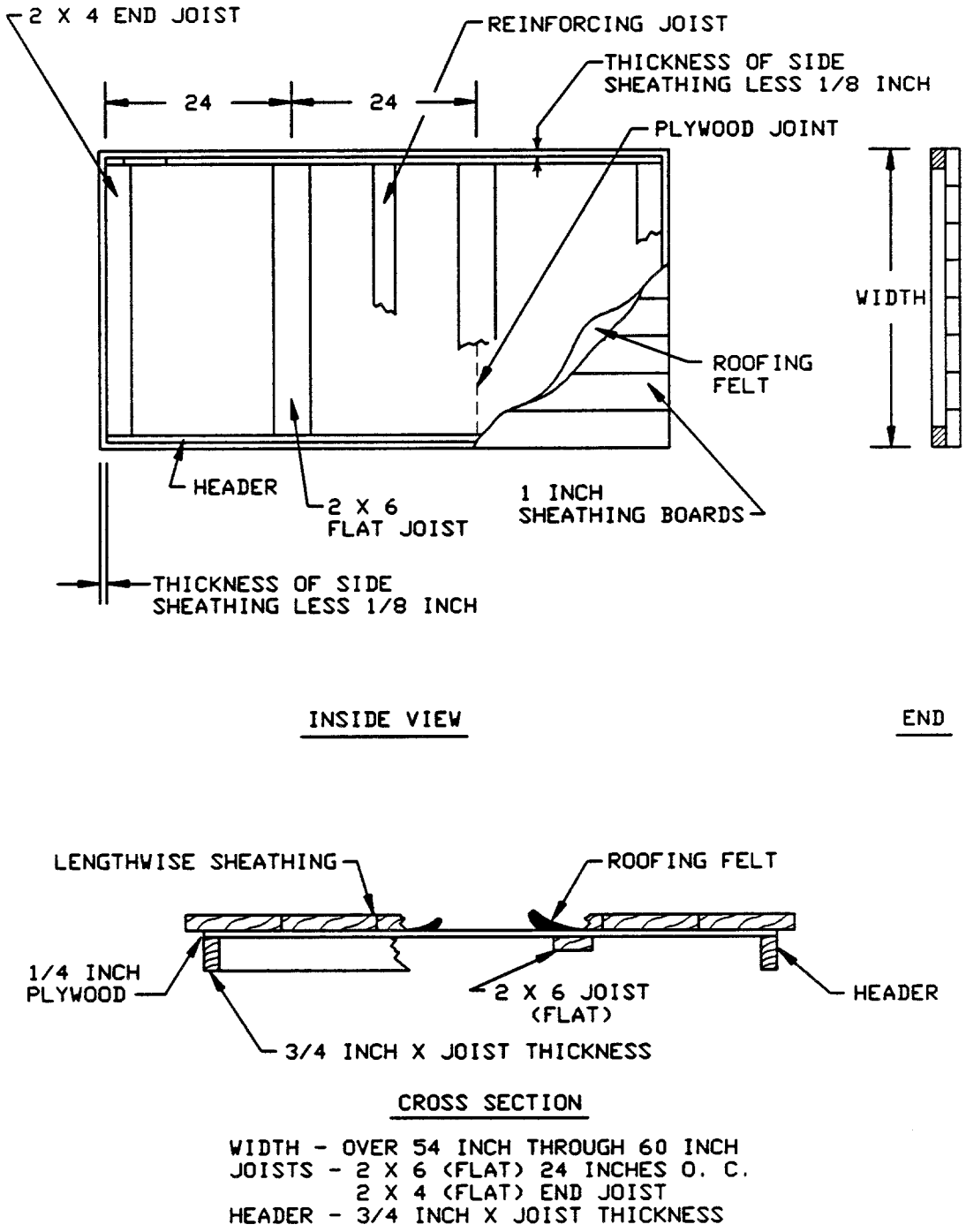
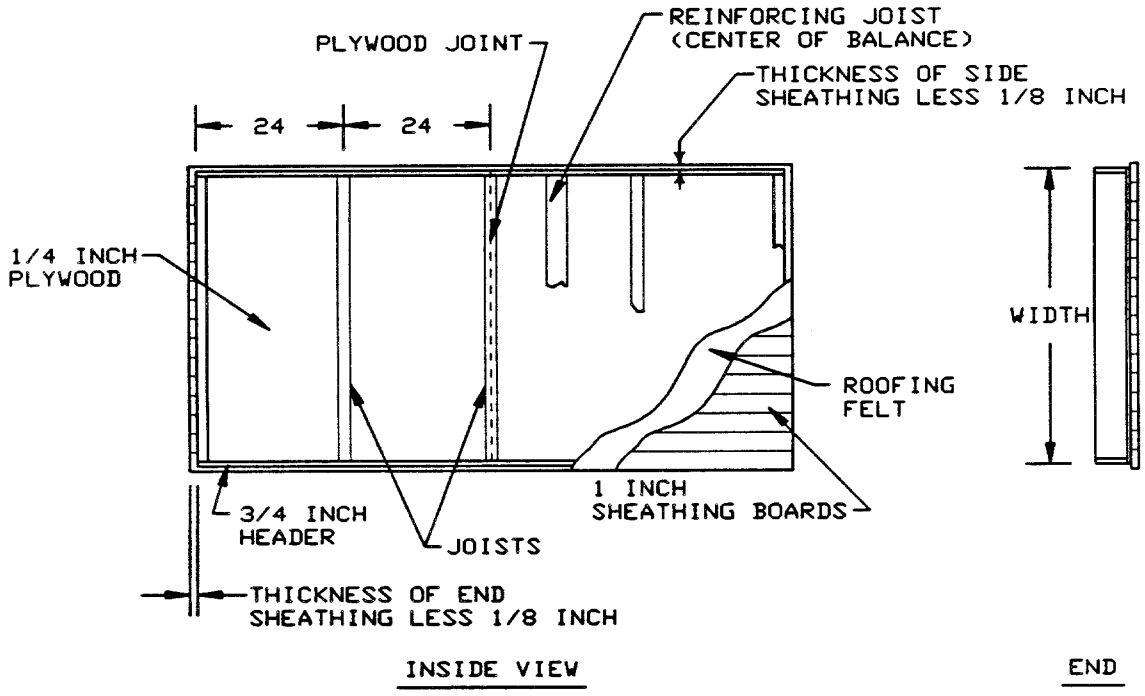
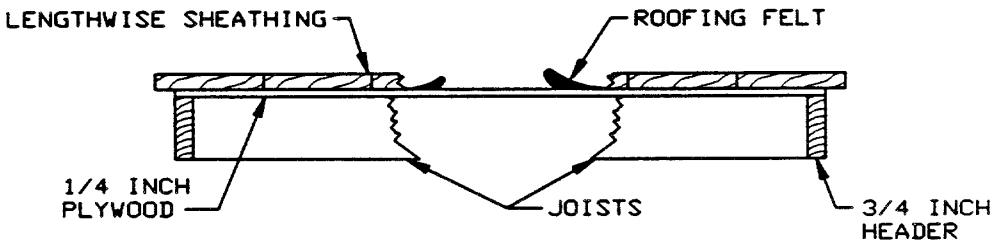


Figure 6-59. Intermediate tops (widths over 54 inches to 60 inches) (MIL-C-104).

MIL-C-104C





WIDTH - OVER 60 INCHES THROUGH 120 INCHES
JOISTS (SPACE 24 INCHES O. C.)

SPAN	SIZE
OVER 60 INCHES THRU 66 INCHES	2 X 4
OVER 66 INCHES THRU 78 INCHES	2 X 4 PLUS 1 X 4 OR 3 X 4 [1/]
OVER 78 INCHES THRU 90 INCHES	2 - 2 X 4 OR 4 X 4 [1/]
OVER 90 INCHES THRU 102 INCHES	2 X 6
OVER 102 INCHES THRU 120 INCHES	2 X 6 PLUS 1 X 6 OR 3 X 6 [1/]

[1/] END JOIST TO BE SINGLE 2 INCH MEMBER AND SAME DEPTH AS JOISTS

HEADERS - 3/4 INCH THICK AND SAME DEPTH AS JOISTS

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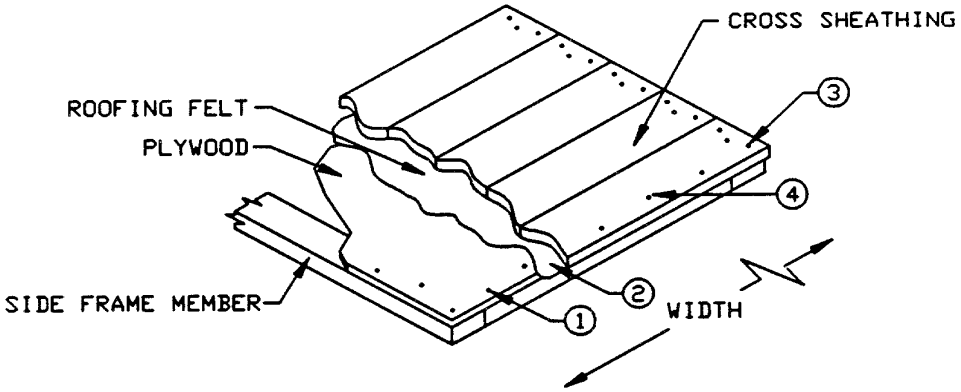
Figure 6-60. Wide tops (widths over 60 inches to 120 inches) (MIL-C-104).

MIL-C-104C



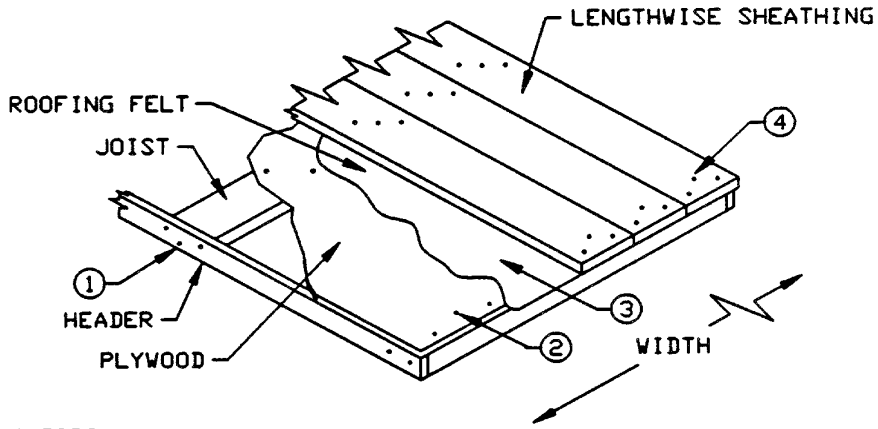
NARROW TOPS

① PLYWOOD TO FRAME MEMBERS
NAILS - 5d CEMENT COATED
SPACING - 8 INCHES O. C.

② ROOFING FELT - 4 INCH LAP AT JOINT - USE MASTIC

③ SHEATHING THROUGH PLYWOOD INTO FRAMING MEMBER
NAILS - 8d CEMENT COATED
SPACING - 3 INCHES O. C. (MINIMUM 2 PER BOARD)

④ AS ③ BUT SPACE 8 INCHES O. C.



INTERMEDIATE TOPS

① HEADER TO FLAT JOIST - 12d CEMENT COATED NAIL, SPACE 2 INCHES O. C.

② PLYWOOD TO JOIST AND HEADER - 5d CEMENT COATED NAIL, SPACE 8 INCHES O. C.

③ ROOFING FELT - 4 INCH LAP AT JOINT - USE MASTIC

④ SHEATHING INTO JOIST - 8d CEMENT COATED NAIL, SPACE 3 INCHES O. C.

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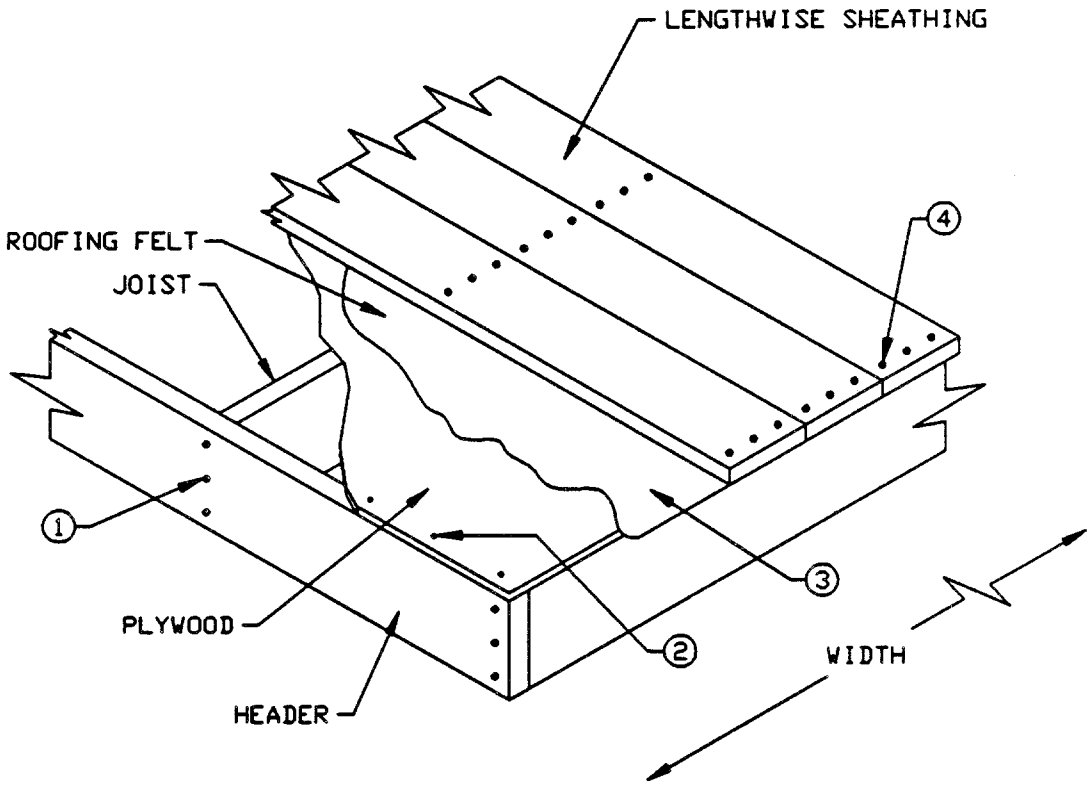
Figure 6-61. Fabrication of tops (narrow and intermediate) (MIL-C-104).

MIL-C-104C



WIDE TOPS

① HEADER TO JOIST - 12d cc NAIL
2 X 4's - 2 NAILS
2 X 6's - 3 NAILS

② PLYWOOD TO JOIST AND HEADER
5d cc NAIL - SPACE 8 IN. ON CENTER

③ ROOFING FELT - 4 IN. LAP AT JOINT - USE MASTIC

④ SHEATHING INTO JOIST - 8d cc NAILS
1 X 4, 1 X 6 - 2 NAILS PER JOIST
1 X 8, 1 X 10 - 3 NAILS PER JOIST

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Figure 6-62. Fabrication of tops (wide top) (MIL-C-104).

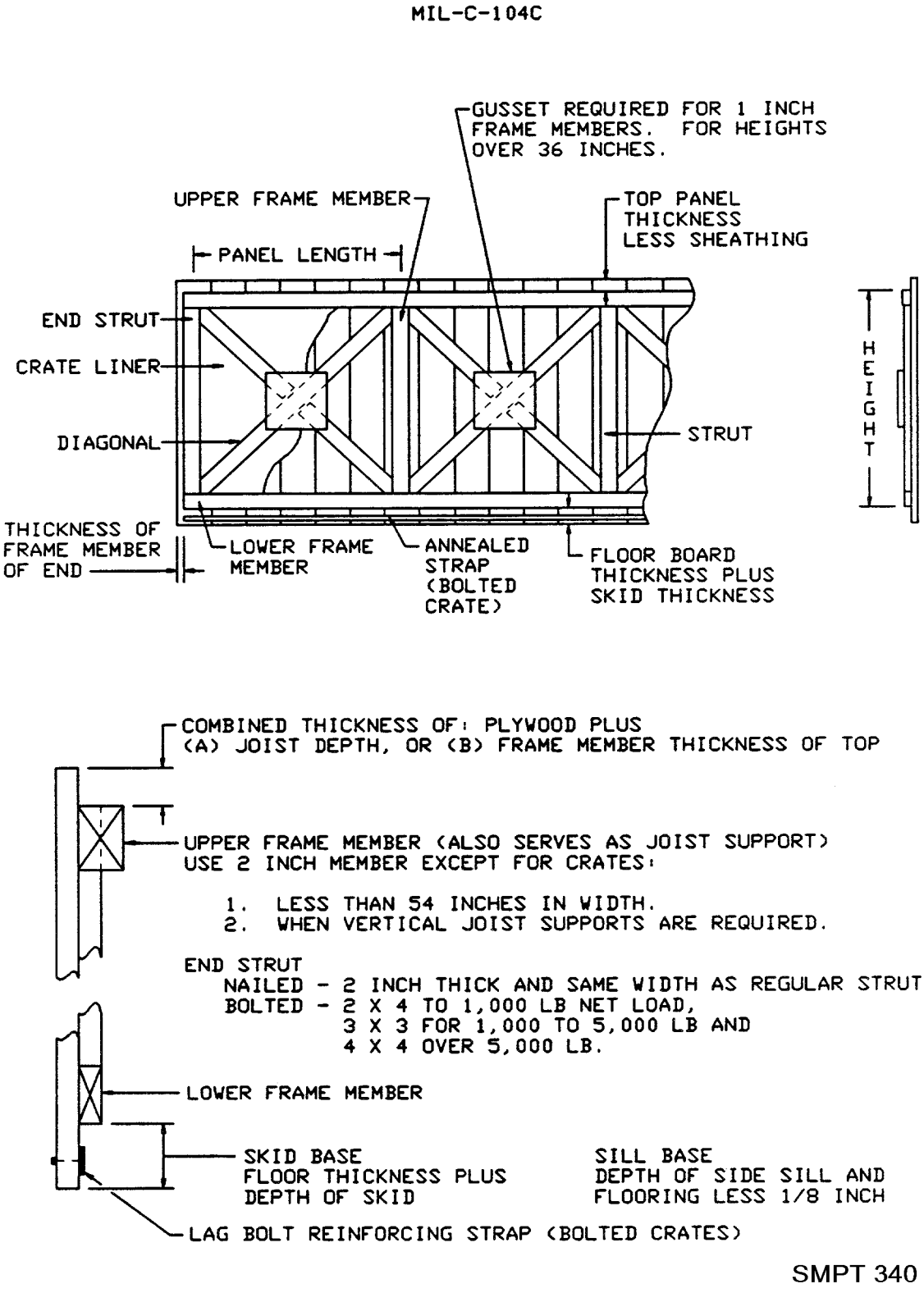


Figure 6-63. Sides type A panel (lumber) (heights over 24 inches to 60 inches) (MIL-C-104).

Liners

A crate liner shall be applied between the sheathing and frame members of sides and ends of all lumber-sheathed crates and shall conform to the crate liners specified in PPP-B-1055. The paper shall be placed horizontally as unrolled, with a 4-inch minimum shingle lap applied for proper drainage and shall cover the entire framed area. Vertical joints, when require, shall have a minimum 4-inch lap and shall be located at a vertical member.

Sheathing

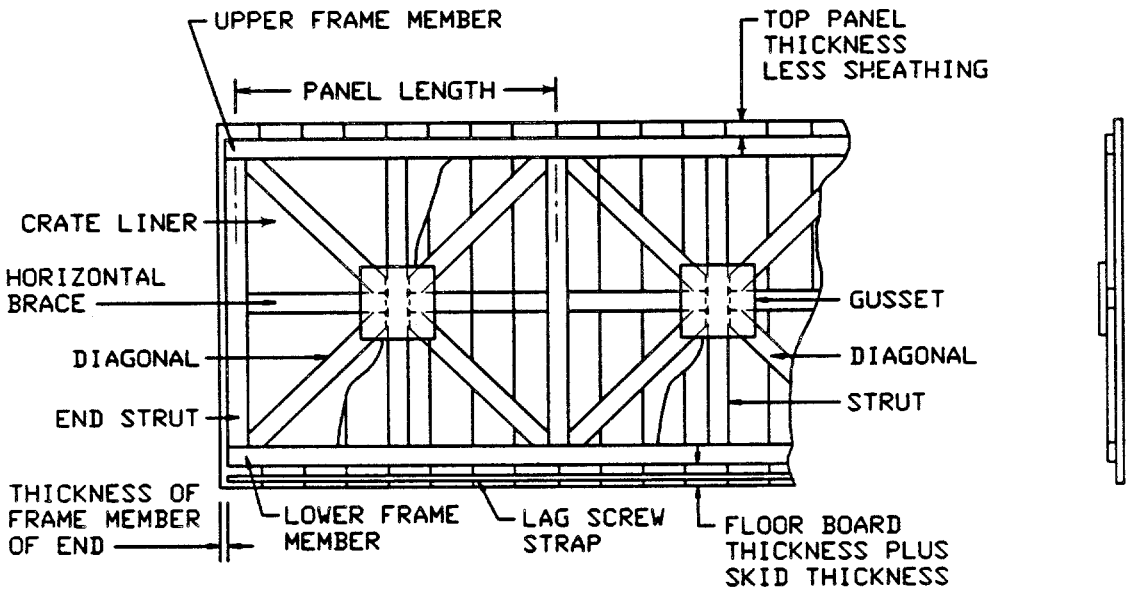
Sheathing for the side and end panels of crates shall be applied vertically, shall extend to the bottom of the skids one side panels and to the tops of skids on the end panels of skid type base crates. Sheathing shall extend to the bottom of sills on sill-type base crates. Sheathing shall be either tongue-and-groove or square and shall be 1 inch thick. At least one side of all boards shall be dressed and the dressed side placed outward. No boards shall be less than 4 inches in width. End boards shall be not less than 6 inches wide and preferably wider. No more than 10 percent of the boards (not more than one out of 10 boards) shall be of the minimum width, nor shall the narrow boards be adjacent to each other. Short boards, not less than 2 feet in length, may be used under the following conditions (figure 6-67):

- boards shall be cut at right angles,
- the center of a short sheathing board shall be at the approximate center of the width of a diagonal and shall have full coverage by the diagonal, or shall be joined on a horizontal member,
- at least every second board and all end boards shall be full length, and
- nailing shall be as shown in figure 6-67.

Fabrication Nailing

Nails securing sheathing to framing up to and including 2 inch thickness shall be driven through the sheathing and shall be of such length as to permit a minimum of 1/4-inch clinch on the framing. For nailing sheathing to horizontal and diagonal frame members 4 to 6 inches wide, three rows of nails shall be used. There shall be a minimum of three nails per crossing in sheathing boards 4 to 6 inches wide and a minimum of four nails in wider boards (figure 6-67). For nailing sheathing to horizontal and diagonal frame members over 6 inches wide, four rows of nails shall be used. There shall be a minimum of four nails per crossing in sheathing boards 4 to 8 inches wide and a minimum of five nails in wider boards (figure 6-65). For nailing sheathing to struts 4 to 6 inches wide, two rows of nails shall be used. The nails shall be spaced approximately 8 inches apart in each row and staggered. For wider struts use three rows of nails. The nails shall be spaced approximately 12 apart and staggered. Nail spacing at vertical butt joints shall be as shown in figure 6-67. Gusset plates shall be secured with sevenpenny nails driven through and clinched on the sheathing. Nailing shall be shown in figure 6-66. Vertical joist supports shall be secured with two tenpenny nails at each horizontal frame member crossing and one tenpenny nails at each diagonal crossing as shown in figure 6-66. Where vertical joists coincide with struts, there shall be two rows of nails on 30 inch centers.

MIL-C-104C



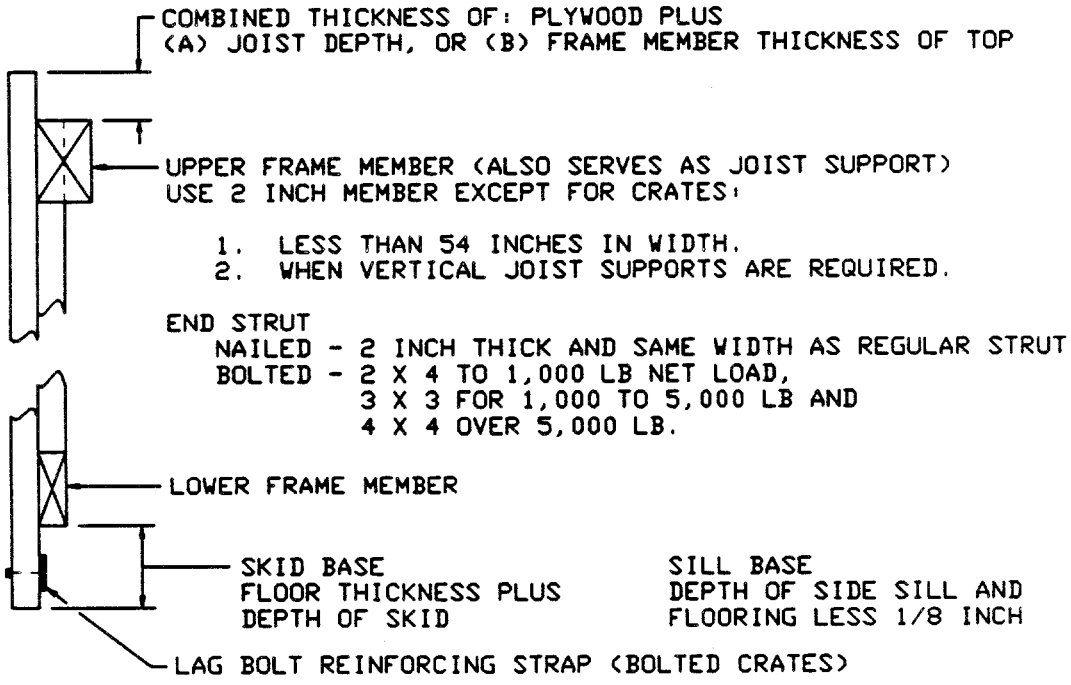


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Figure 6-64. Sides type B panel (lumber) (heights over 60 inches to 108 inches) (MIL-C-104).

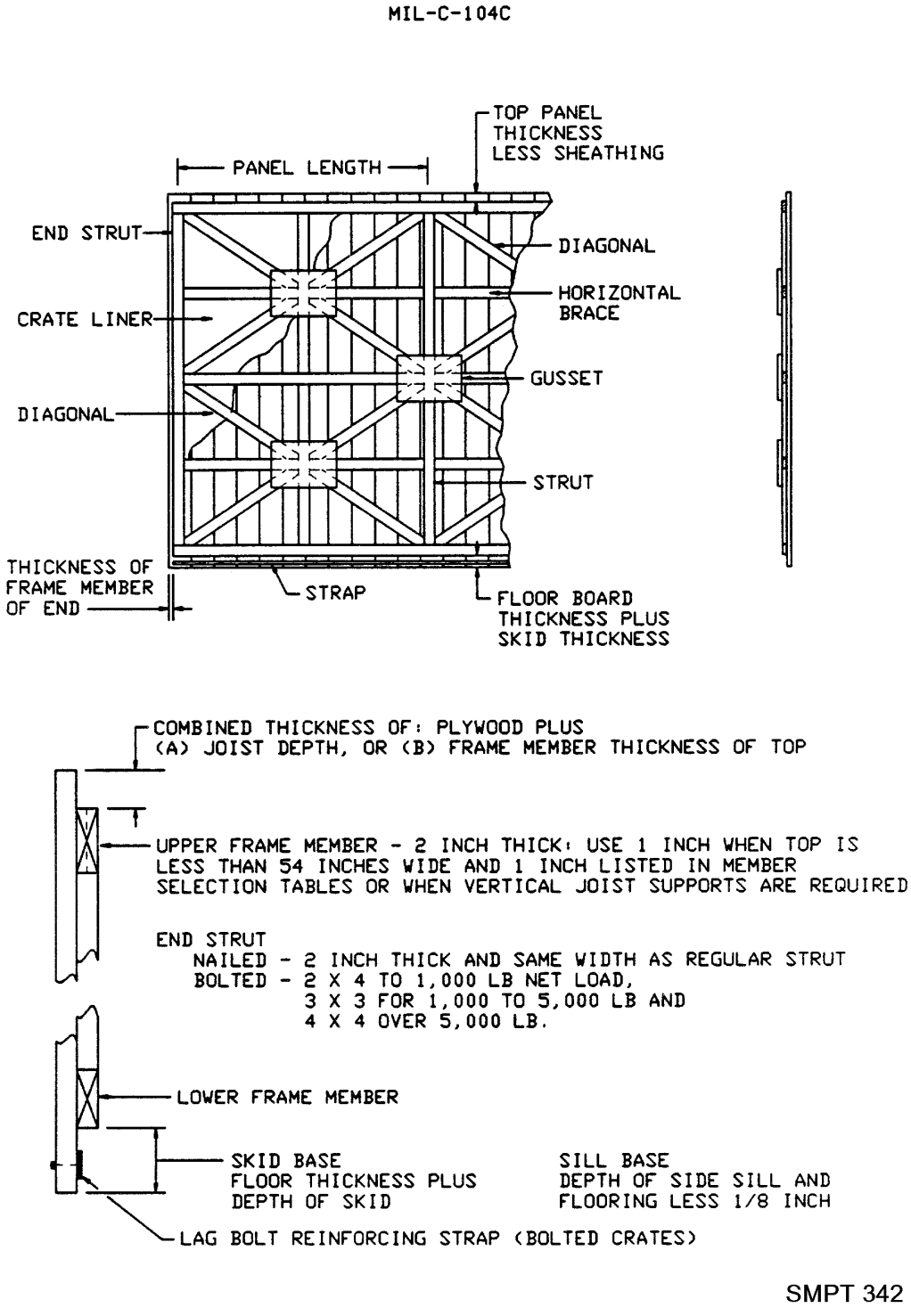

Figure 6-65. Sides type C panel (lumber) (heights over 108 inches to 144 inches) (MIL-C-104).

Lag Screw Reinforcing Strap for Bolted Crates

Reinforcing strap shall be used on side and end panels of all demountable crates as shown in figures 6-68, 6-69 and 6-70. Galvanized steel strap, punched or drilled, 1-1/4 inches by 0.035 inch of 3/4 inch lag screws, and 2 inches by 0.050 inch for 1/2 and 5/8 inch lag screws, shall be nailed to the inner face of the sheathing between the lower edge of the bottom frame member and the bottom of the sheathing as shown in figure 6-68. The strap shall be located to coincide with the center of the skid or header and shall be nailed on maximum 2 inch centers to the sheathing with clout or similar nails. Nails shall be clinched at least 3/8 inch.

Ends

End types and size of members for ends in crates over 30 inches wide shall be determined in a manner similar to the sides, except that in all cases the thickness of the upper and lower frame members shall be the same as the struts specified in tables 6-34 to 6-43. The member arrangement shall conform, to the details shown in figure 6-81. For crates less than 30 inches wide, single diagonals only are required and all frame members shall be 1 by 4 inches in size as shown in figure 6-81.

ASSEMBLY (CLASS 1 CRATES)

BOLTED CRATE

General

Type II (bolted) crates shall be assembled with lag bolts. Lead holes shall be used for lag bolts.

Fastening Sides to Base

The sides shall be secured to the skids with lag bolts. For 3 X 4 inch skids, 3/8 inch diameter by 3-inch long lag bolts shall be used; for 4 X 4 inch skids, 1/2 inch diameter by 4 inch long lag bolts shall be used. The number of lag bolts shall be as specified in table 6-44. One-half the number shall be used on each side and the spacing shall be uniform along the skid. Maximum spacing shall be 16 inches for 3/8-inch lag bolts and 20 inches for 1/2 inch lag bolts. Lead holes shall be drilled in line with and through the center of the metal reinforcing strap, as well as through the sheathing and into the skid. Assembly and placement details shall be as shown on figures 6-71 and 6-72.

Fastening Sides to Top

Lag bolts, 3/8 inch diameter by 3-1/2 inches long, shall be used to fasten the sides to the top. These lag bolts shall be placed so that there is one in the end of each joist at the approximate center (figure 6-73). For tops without joists, lag bolts shall be placed at the approximate center of the side frame member of the top and spaced no greater than 24 inches apart.

Fastening Ends to Top, Sides, and Base

Lag bolts for fastening ends to tops shall be 3/8 inch in diameter by 2-1/2 inches long. Lag bolts for fastening ends to sides shall be 3/8 inch diameter by 3-1/2 inches long. Placement and other assembly details shall be as shown in figure 6-71 and 6-73. Lag bolts for fastening ends to base shall be the same size. Location and spacing shall be as shown in figures 6-71 and 6-72. Lead holes shall be centered on the reinforcing strap.

Table 6-34. Panel member selection table for 1,000 lb. net load*

Note. All blank spaces are 1X4s

Length (ft.)	Member	4 foot width Height (ft.)						6 foot width Height (ft.)						8 foot width Height (ft.)						10 foot width Height (ft,.)					
		2	4	6	8	10	12	2	4	6	8	10	12	2	4	6	8	10	12	2	4	6	8	10	12
6	Upper frame							2x4	2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4	2x4	2x4
	Lower frame																	2x4						2x4	2x4
	Struts																	2x4						2x4	2x4
	Diagonal																								
8	Upper frame							2x4	2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4	2x4	2x4
	Lower frame																	2x4						2x4	2x4
	Struts																	2x4					1x6	2x4	2x4
	Diagonal																								
10	Upper frame							2x4	2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4	2x4	2x4
	Lower frame																	2x4						2x4	2x4
	Struts																	2x4					1x6	2x4	2x4
	Diagonal																								
12	Upper frame							2x4	2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4	2x4	2x4
	Lower frame																	2x4						2x4	2x4
	Struts																	2x4					1x6	2x4	2x4
	Diagonal																								
16	Upper frame							2x4	2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4	2x4	2x4
	Lower frame																	2x4						2x4	2x4
	Struts																1x6	2x4			1x6		1x6	2x4	2x4
	Daigonal																								
20	Upper frame							2x4	2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4	2x4	2x4
	Lower frame																	2x4						2x4	2x4
	Struts																1x6	2x4			1x6		1x8	2x4	2x4
	Diagonal																						1x6		1x6
24	Upper frame	1x6						1x6	2x4	2x4	2x4	2x4		1x6	2x4	2x4	2x4	2x4		1x6	2x4	2x4	2x4	2x4	2x4
	Lower frame																	2x4						2x4	2x4
	Struts	1x6						1x6			1x6			1x6	1x6		1x6	2x4		1x6	1x6		1x8	2x4	2x4
	Diagonal	1x6						1x6						1x6			1x6			1x6			1x6		1x6
28	Upper frame	1x6						1x6	2x4	2x4	2x4	2x4		1x6	2x4	2x4	2x4	2x4		1x6	2x4	2x4	2x4	2x4	2x4
	Lower frame																	2x4					2x4	2x4	2x4
	Struts										1x6			1x6	1x6		1x8	2x4		1x6	1x6		2x4	2x4	2x4
	Diagonal	1x6						1x6						1x6			1x6	1x6		1x6			2x4	1x6	1x4
32	Upper frame	1x6						1x6	2x4	2x4	2x4	2x4		1x6	2x4	2x4	2x4	2x4		1x6	2x4	2x4	2x4	2x4	2x4
	Lower frame																2x4	2x4					2x4	2x4	2x4
	Struts										1x6			1x6	1x6		2x4	2x4		1x6	1x6	1x6	2x4	2x4	2x4
	Diagonal	1x6		1x6				1x6			1x6	1x6		1x6			2x4	2x4		1x6		1x6	2x4	2x4	2x4

*Crates 12 feet high in 8-foot widths and crates 10 feet high in 6-foot widths require 2x4 vertical joists supports when struts are 1 inch thick; all other sizes use horizontal joist supports.

Table 6-35. Panel member selection table for 2,000 lb. net load

Note. All balnk spaces are 1x4s.

		4 foot width						6 foot width						8 foot width						10 foot width					
Length		Height (ft.)						Height (ft.)						Height (ft.)						Height (ft,.)					
(ft.)	Member	2	4	6	8	10	12	2	4	6	8	10	12	2	4	6	8	10	12	2	4	6	8	10	12
6	Upper frame							2x4	2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4	2x4	2x4	2x4
	Lower frame																		2x4					2x4	2x4
	Struts																		2x4					2x4	2x4
	Diagonal																								
8	Upper frame							2x4	2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4	2x4	2x4	2x4
	Lower frame																		2x4					2x4	2x4
	Struts																		2x4				1x6	2x4	2x4
	Diagonal																								
10	Upper frame							2x4	2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4	2x4	2x4	2x4
	Lower frame																		2x4					2x4	2x4
	Struts																		2x4				1x6	2x4	2x4
	Diagonal																1x6						1x6		
12	Upper frame							2x4	2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4	2x4	2x4	2x4
	Lower frame																		2x4					2x4	2x4
	Struts																		2x4				1x6	2x4	2x4
	Diagonal																						1x6		
16	Upper frame							2x4	2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4	2x4	2x4	2x4
	Lower frame																		2x4					2x4	2x4
	Struts																1x6		2x4		1x6		1x6	2x4	2x4
	Diagonal																1x6						1x6		1X6
20	Upper frame							2x4	2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4	2x4	2x4	2x4
	Lower frame																		2x4				2x4	2x4	2x4
	Struts																1x6		2x4		1x6		2x4	2x4	2x4
	Diagonal																1x6		1x6				2x4		1x6
24	Upper frame	1x6						1x6	2x4	2x4	2x4	2x4		1x6	2x4	2x4	2x4		2x4	1x6	2x4	2x4	2x4	2x4	2x4
	Lower frame																2x4		2x4				2x4	2x4	2x4
	Struts	1x6						1x6			1x6			1x6	1x6		2x4		2x4	1x6	1x6		2x4	2x4	2x4
	Diagonal	1x6						1x6			1x6			1x6			2x4		1x6	1x6			2x4	1x6	2x4
28	Upper frame	1x6						1x6	2x4	2x4	2x4	2x4		1x6	2x4	2x4	2x4		2x4	1x6	2x4	2x4	2x4	2x4	2x4
	Lower frame																2x4		2x4				2x4	2x4	2x4
	Struts	1x6						1x6			1x6			1x6	1x6		2x4		2x4	1x6	1x6		2x4	2x4	2x4
	Diagonal	1x6						1x6			1x6		1x6	1x6			2x4		2x4	1x6			2x4	1x6	2x4
32	Upper frame	1x6	1x6		2x4			1x6	2x4	2x4	2x4	2x4		1x6	2x4	2x4	2x4		2x4	1x6	2x4	2x4	2x4	2x4	2x4
	Lower frame				2x4						2x4						2x4		2x4				2x4	2x4	2x4
	Struts	1x6			2x4			1x6			2x4			1x6	1x6		2x4		2x4	1x6	1x6	1x6	2x4	2x4	2x4
	Diagonal	1x6			2x4			1x6			2x4		1x6	1x6			2x4	1x6	2x4	1x6		1x6	2x4	2x4	2x4

*Crates 12 feet high in 6-foot widths and crates 10 feet high in 8-foot widths require 2x4 vertical joists supports when struts are 1 inch thick; all other sizes use horizontal joist supports.

Table 6-36. Panel member selection table for 4,000 lb. net load

Note. All balnk spaces are 1x4s.

		4 foot width						6 foot width						8 foot width						10 foot width					
Length		Height (ft.)						Height (ft.)						Height (ft.)						Height (ft,.)					
(ft.)	Member	2	4	6	8	10	12	2	4	6	8	10	12	2	4	6	8	10	12	2	4	6	8	10	12
6	Upper frame							2x4	2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4	2x4	2x4	2x4
	Lower frame																		2x4					2x4	2x4
	Struts																		2x4					2x4	2x4
	Diagonal																						1x6		
8	Upper frame							2x4	2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4	2x4	2x4	2x4
	Lower frame																		2x4					2x4	2x4
	Struts																		2x4				1x6	2x4	2x4
	Diagonal										1x6						1x6						1x6		1x6
10	Upper frame							2x4	2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4	2x4	2x4	2x4
	Lower frame																2x4		2x4				2x4	2x4	2x4
	Struts																2x4		2x4				2X4	2x4	2x4
	Diagonal				1x6						1x6						2x4						2X4		
12	Upper frame							2x4	2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4	2x4	2x4	2x4
	Lower frame																		2x4				2x4	2x4	2x4
	Struts																		2x4				2x4	2x4	2x4
	Diagonal				1x6						1x6						1x6						2x4		1x6
16	Upper frame	1x6						2x4	2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4	2x4	2x4	2x4
	Lower frame																2x4		2x4				2x4	2x4	2x4
	Struts																2x4		2x4		1x6		2x4	2x4	2x4
	Diagonal				1x6						1x6						2x4		1X6				2x4		1x6
20	Upper frame	1x6						2x4	2x4	2x4	2x4	2X4		2x4	2x4	2x4	2x4		2x4	2x6	2x4	2x4	2x4	2x4	2x4
	Lower frame																2x4		2x4				2x4	2x4	2x4
	Struts																2x4		2x4		1x6		2x4	2x4	2x4
	Diagonal				1x6						1x6						2x4		1x6		1x6		2x4	1x6	1x6
24	Upper frame	1x6	1x6					1x6	1x6	2x4	2x4	2x4		1x6	1x6	2x4	2x4		2x4	1x6	1X6	2x4	2x4	2x4	2x4
	Lower frame										2x4						2x4		2x4				2x4	2x4	2x4
	Struts	1x6						1x6			2x4			1x6	1x6		2x4		2x4	1x6	1x6		2x4	2x4	2x4
	Diagonal	1x6			1x6			1x6			2x4		1x6	1x6			2x4	1x6	2x4	1x6		1x6	2x4	1x6	2x4
28	Upper frame	1x6	1x6					1x6	2x4	2x4	2x4	2x4		1x6	1x6	2x4	2x4		2x4	1x6	2x4	2x4	2x4	2x4	2x4
	Lower frame	1x6						1x6			2x4			1x6			2x4		2x4	1x6			2x4	2x4	2x4
	Struts	1x6						1x6			2x4			1x6	1x6		2x4		2x4	1x6	1x6		2x4	2x4	2x4
	Diagonal	1x6			1x6			1x6			2x4		1x6	1x6			2x4	1x6	2x4	1x6			2x4	2x4	2x4
32	Upper frame	1x6	1x6		2x4			1x6	2x4	2x4	2x4	2x4	2x4	1x6	1x6	2x4	2x4		2x4	1x6	2x4	2x4	2x4	2x4	2x4
	Lower frame	1x6	1x6		2x4			1x6			2x4		2x4	1x6			2x4		2x4	1x6			2x4	2x4	2x4
	Struts	1x6			2x4			1x6			2x4		2x4	1x6	1x6		2x4		2x4	1x6	1x6	1x6	2x4	2x4	2x4
	Diagonal	1x6			2x4		1x6	1x6			2x4	1x6	2x4	1x6	1x6		2x4	1x6	2x4	1x6		1x6	2x4	2x4	2x6

*Crates 12 feet high in 6-foot widths and crates 10 feet high in 8-foot widths require 2x4 vertical joists supports when struts are 1 inch thick; all other sizes use horizontal joist supports.

Table 6-37. Panel member selection table for 6,000 lb. net load

Note. All balnk spaces are 1x4s.

		4 foot width						6 foot width						8 foot width						10 foot width					
Length		Height (ft.)						Height (ft.)						Height (ft.)						Height (ft,.)					
(ft.)	Member	2	4	6	8	10	12	2	4	6	8	10	12	2	4	6	8	10	12	2	4	6	8	10	12
	Upper frame							2x4	2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4	2x4	2x4	2x4
6	Lower frame																		2x4				2x4	2x4	2x4
	Struts																		2x4				2x4	2x4	2x4
	Diagonal				1x6						1x6						1x6		2x4				2x4		
	Upper frame							2x4	2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4	2x4	2x4	2x4
8	Lower frame										2x4								2x4				2x4	2x4	2x4
	Struts										2x4								2x4				2x4	2x4	2x4
	Diagonal				1x6		1x6				2x4		1x6		1x6	2x4	1x6					1x6	2x4		2x4
	Upper frame				2x4			2x4	2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4	2x4	2x4	2x4
10	Lower frame				2x4						2x4						2x4		2x4				2x4	2x4	2x4
	Struts				2x4						2x4						2x4		2x4				2x4	2x4	2x4
	Diagonal				2x4						2x4		1x6				2x4		1x6			1x6	2x4	2x4	2x4
	Upper frame	1x6			2x4			2x4	2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4	2x4	2x4	2x4
12	Lower frame				2x4						2x4						2x4		2x4				2x4	2x4	2x4
	Struts				2x4						2x4						2x4		2x4				2x4	2x4	2x4
	Diagonal				2x4						2x4		1x6				2x4	1x6	1x6			1x6	2x4	1x6	2x4
	Upper frame	2x6			2x4			2x4	2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4		2x4	2x6	2x4	2x4	2x4	2x4	2x4
16	Lower frame				2x4						2x4						2x4		2x4				2x4	2x4	2x4
	Struts				2x4						2x4						2x4		2x4		1x6		2x4	2x4	2x4
	Diagonal				2x4						2x4		1x6				2x4	1x6	1x6			1x6	2x4	1x6	2x4
	Upper frame	2x6	1x6		2x4			2x4	2x4	2x4	2x4	2x4		2x6	2x4	2x4	2x4		2x4	2x6	2x4	2x4	2x4	2x4	2x4
20	Lower frame				2 x4						2x4						2x4		2x4				2x4	2x4	2x4
	Struts				2x4						2x4	1x6	1x6	2x4	1x6	2x4	1x6	2x4			1x6		2x4	2x4	2x4
	Diagonal				2x4					1x6	2x4		1x6			1x6	2x4	1x6	2x4			1x6	2x4	1x6	2X4
	Upper frame	1x6	1x6	1x6	2x4			1x6	1x6	1x6	2x4	2x4	2x4	1x6	2x6	2x4	2x4	2x4	2x4	1x6	2x6	2x4	2x4	2x4	2x4
24	Lower frame	1x6			2x4			1x6			2x4		2x4	1x6			2x4	2X4	2x4	1x6			2x4	2x4	2x4
	Struts	1x6			2x4			1x6			2x4	1x6	2x4	1x6	1x6		2x4	2X4	2x4	1x6	1x6		2x4	2x4	2x4
	Diagonal	1x6			2x4		1x6	1x6		1x6	2x4	1x6	2x4	1x6		1x6	2x4	2x4	2x4	1x6		1x6	2x4	1x6	2x4
	Upper frame	1x6	2x4	1x6	2x4			1x6	2x4	2x4	2x4	2x4	2x4	2x6	2x6	2x4	2x4	2x4	2x4	2x6	2x6	2x4	2x4	2x4	2x4
28	Lower frame	1x6			2x4			1x6			2x4		2x4	1x6			2x4	2x4	2x4	1x6		2X4	2x4	2x4	2x4
	Struts	1x6			2x4			1x6			2x4		2x4	1x6	1x6		2x4	2x4	2x4	1x6	1x6	2X4	2x4	2x4	2x4
	Diagonal	1x6			2x4		1x6	1x6		1x6	2x4	1x6	2x4	1x6		1x6	2x4	2x4	2x4	1x6		2X4	2x4	2x4	2x6
	Upper frame	2x6	2x6	1x6	2x4		2x4	2x6	2x6	2x4	2x4	2x4	2x4	2x6	2x6	2x4	2x4	2x4	2x4	2x6	2x6	2x4	2x4	2x4	2x4
32	Lower frame	1x6			2x4		2x4	1x6			2x4		2x4	1x6		2x4	2x4	2x4	2x4	1x6		2X4	2x4	2x4	2x4
	Struts	1x6			2x4		2x4	1x6			2x4		2x4	1x6	1x6	2x4	2x4	2x4	2x4	1x6	1x6	1x6	2x4	2x4	2x4
	Diagonal	1x6		1x6	2x4	1x6	2x4	1x6		1x6	2x4	1x6	2x4	1x6		2x4	2x4	2x4	2x4	1x6	1x6	2X4	2x6	2x6	2x6

*Crates 12 feet high in 6-foot widths and crates 10 feet high in 8-foot widths require 2x4 vertical joists supports when struts are 1 inch thick; all other sizes use horizontal joist supports.

Table 6-38. Panel member selection table for 8,000 lb. net load.*

Note. All balnk spaces are 1x4s.

		4 foot width						6 foot width						8 foot width						10 foot width					
Length		Height (ft.)						Height (ft.)						Height (ft.)						Height (ft,.)					
(ft.)	Member	2	4	6	8	10	12	2	4	6	8	10	12	2	4	6	8	10	12	2	4	6	8	10	12
	Upper frame				2x4			2x4	2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4	2x4	2x4	2x4
6	Lower frame				2x4						2x4								2x4				2x4	2x4	2x4
	Struts				2x4						2x4								2x4				2x4	2x4	2x4
	Diagonal			1x6	2x4		1x6			1x6	2x4	1x6	1x6				1x6		2x4				2x4		
	Upper frame	1x6		2x4			2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4	2x4	2x4	2x4
8	Lower frame				2x4		2x4				2x4								2x4				2x4	2x4	2x4
	Struts				2x4		2x4				2x4								2x4				2x4	2x4	2x4
	Diagonal			1x6	2x4		2x4				2x4		1x6		1x6	2x4	1x6					1x6	2x4		2x4
	Upper frame	1x6			2x4			2x4	2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4	2x4	2x4	2x4
10	Lower frame				2x4						2x4						2x4		2x4				2x4	2x4	2x4
	Struts				2x4						2x4						2x4		2x4				2x4	2x4	2x4
	Diagonal				2x4		1x6				2x6		1x6				2x4		1x6			1x6	2x4	2x4	2x4
	Upper frame	2x6			2x4			2x4	2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4	2x4	2x4	2x4
12	Lower frame				2x4						2x4						2x4		2x4				2x4	2x4	2x4
	Struts				2x4						2x4						2x4		2x4				2x4	2x4	2x4
	Diagonal			1x6	2x4	1x6	1x6				2x4		1x6				2x4	1x6	1x6			1x6	2x4	1x6	2x4
	Upper frame	2x6			2x4			2x4	2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4		2x4	2x6	2x4	2x4	2x4	2x4	2x4
16	Lower frame				2x4						2x4						2x4		2x4				2x4	2x4	2x4
	Struts				2x4						2x4						2x4		2x4		1x6		2x4	2x4	2x4
	Diagonal			1x6	2x4	1x6	1x6				2x4		1x6				2x4	1x6	1x6			1X6	2x4	1x6	2x4
	Upper frame	2x6	1x6		2x4			2x4	2x4	2x4	2x4	2x4		2x6	2x4	2x4	2x4		2x4	2x6	2x4	2x4	2x4	2x4	2x4
20	Lower frame				2x4						2x4						2x4		2x4				2x4	2x4	2x4
	Struts				2x4						2x4	1x6	1x6	2x4	1x6	2x4	1x6	2x4			1x6		2x4	2x4	2x4
	Diagonal			1x6	2x4	1x6	1x6			1x6	2x4		1x6			1x6	2x4	1x6	2x4			1x6	2x4	1x6	2x4
	Upper frame	2x6	2x6	1x6	2x4		2x4	1x6	1x6	1x6	2x4	2x4	2x4	1x6	2x6	2x4	2x4	2x4	2x4	1x6	2x6	2x4	2x4	2x4	2x4
24	Lower frame	1x6			2x4		2x4	1x6			2x4		2x4	1x6			2x4	2x4	2x4	1x6			2x4	2x4	2x4
	Struts	1x6			2x4	1x6	2x4	1x6			2x4	1x6	2x4	1x6	1x6		2x4	2x4	2x4	1x6	1x6		2x4	2x4	2x4
	Diagonal	1x6		1x6	2x4	1x6	2x4	1x6		1x6	2x4	1x6	2x4	1x6		1x6	2x4	2x4	2x4	1x6		1x6	2x4	1x6	2x4
	Upper frame	2x6	2x6	2x4	2x4	2x4	2x4	1x6	2x4	2x4	2x4	2x4	2x4	2x6	2x6	2x4	2x4	2x4	2x4	2x6	2x6	2x4	2x4	2x4	2x4
28	Lower frame	1x6		2x4	2x4	2x4	2x4	1x6			2x4		2x4	1x6			2x4	2x4	2x4	1x6		2x4	2x4	2x4	2x4
	Struts	1x6		2x4	2x4	2x4	2x4	1x6			2x4		2x4	1x6	1x6		2x4	2x4	2x4	1x6	1x6	2x4	2x4	2x4	2x4
	Diagonal	1x6		2x4	2x4	2x4	2x4	1x6		1x6	2x4	1x6	2x4	1x6		1x6	2x4	2x4	2x4	1x6		2x4	2x4	2x4	2x6
	Upper frame	2x8	2x8	1x6	2x4		2x4	2x6	2x6	2x4	2x4	2x4	2x4	2x6	2x6	2x4	2x4	2x4	2x4	2x6	2x6	2x4	2x4	2x4	2x4
32	Lower frame	1x8			2x4		2x4	1x6			2x4		2x4	1x6		2x4	2x4	2x4	2x4	1x6		2x4	2x4	2x4	2x4
	Struts	1x8			2x4		2x4	1x6			2x4		2x4	1x6	1x6	2x4	2x4	2x4	2x4	1x6	1x6	1x6	2x4	2x4	2x4
	Diagonal	2x8		1x6	2x4	1x6	2x4	1x6		1x6	2x4	1x6	2x4	1x6		2x4	2x4	2x4	2x4	1x6	1x6	2x4	2x6	2x6	2x6

*Crates 12 feet high in 6-foot widths and crates 10 feet high in 8-foot widths require 2x4 vertical joists supports when struts are 1 inch thick; all other sizes use horizontal joist supports.

Table 6-39. Panel member selection table for 10,000 lb. net load.*

Note. All balnk spaces are 1x4s.

		4 foot width						6 foot width						8 foot width						10 foot width					
Length		Height (ft.)						Height (ft.)						Height (ft.)						Height (ft,.)					
(ft.)	Member	2	4	6	8	10	12	2	4	6	8	10	12	2	4	6	8	10	12	2	4	6	8	10	12
	Upper frame				2x4		2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4	2x4	2x4	2x4
6	Lower frame				2x4		2x4				2x4		2x4			2x4	2x4		2x4			2x4	2x4	2x4	2x4
	Struts				2x4	1x6	2x4			1x6	2x4	1x6	2x4		1x6	2x4	2x4	1x6	2x4		1x6	2x4	2x4	2x4	2x4
	Diagonal			1x6	2x4	1x6	2x4			1x6	2x4	1x6	2x4			2x4	2x4	1x6	2x4		1x6	2x4	2x4	2x4	2x4
	Upper frame	1x6		2x4	2x4		2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4	2x4	2x4	2x4
8	Lower frame			2x4	2x4		2x4			2x4	2x4		2x4			2x4	2x4		2x4			2x4	2x4	2x4	2x4
	Struts			2x4	2x4	1x6	2x4			2x4	2x4	1x6	2x4		1x6	2x4	2x4	1x6	2x4		1x6	2x4	2x4	2x4	2x4
	Diagonal		1x6	2x4	2x4	1x6	2x4	1x6	1x6	2x4	2x4	1x6	2x4	1x6	1x6	2x4	2x4	1x6	2x4	1x6	1x6	2x4	2x4	1x6	2x6
	Upper frame	1x6			2x4		2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4		2x4	2x4	2x4	2x4	2x4	2x4	2x4
10	Lower frame				2x4		2x4				2x4		2x4				2x4		2x4			2x4	2x4	2x4	2x4
	Struts			1x6	2x4	1x6	2x4			1x6	2x4	1x6	2x4			1x6	2x4	1x6	2x4			2x4	2x4	2x4	2x4
	Diagonal		1x6	1x6	2x4	1x6	2x4	1x6	1x6	1x6	2x6	1x6	2x4	1x6	1x6	1x6	2x6	1x6	2x4	1x6	1x6	2x4	2x6	2x4	2x4
	Upper frame	2x6			2x4		2x4	2x6	2x4	2x4	2x4	2x4	2x4	2x6	2x4	2x4	2x4	2x4	2x4	2x6	2x4	2x4	2x4	2x4	2x4
12	Lower frame				2x4		2x4			2x4	2x4	2x4	2x4			2x4	2x4	2x4	2x4			2x4	2x4	2x4	2x4
	Struts			1x6	2x4	1x6	2x4			2x4	2x4	2x4	2x4			2x4	2x4	2x4	2x4			2x4	2x4	2x4	2x4
	Diagonal		1x6	1x6	2x4	1x6	2x4	1x6	1x6	2x4	2x4	2x4	2x4	1x6	1x6	2x4	2x4	2x4	2x4	1x6	1x6	2x4	2x4	2x4	2x4
	Upper frame	2x8	1x6		2x4		2x4	2x8	2x4	2x4	2x4	2x4	2x4	2x8	2x4	2x4	2x4	2x4	2x4	2x8	2x4	2x4	2x4	2x4	2x4
16	Lower frame				2x4		2x4			2x4	2x4	2x4	2x4			2x4	2x4	2x4	2x4			2x4	2x4	2x4	2x4
	Struts				2x4	1x6	2x4			2x4	2x4	2x4	2x4		1x6	2x4	2x4	2x4	2x4		1x6	2x4	2x4	2x4	2x4
	Diagonal	1x6	1x6	1x6	2x4	1x6	2x4	1x6	1x6	2x4	2x4	2x4	2x4	1x6	1x6	2x4	2x6	2x4	2x4	1x6	1x6	2x4	2x6	2x6	2x4
	Upper frame	2x8	2x4	2x4	2x4		2x4	2x8	2x6	2x4	2x4	2x4	2x4	2x8	2x6	2x4	2x4	2x4	2x4	2x8	2x6	2x4	2x4	2x4	2x4
20	Lower frame	1x6		2x4	2x4		2x4	1x6		2x4	2x4	2x4	2x4	1x6		2x4	2x4	2x4	2x4	1x6	2x4	2x4	2x4	2x4	2x4
	Struts			2x4	2x4	1x6	2x4			2x4	2x4	2x4	2x4			2x4	1x6	2x4	2x6		2x4	2x4	2x4	2x4	2x6
	Diagonal	1x6		2x4	2x4	1x6	2x4	1x6	1x6	2x4	2x4	2x4	2x4	1x6	1x6	2x4	2x6	2x4	2x6	1x6	2x4	2x4	2x6	2x6	2x6
	Upper frame	2x8	2x6	2x4	2x4	2x4	2x4	2x8	2x6	2x6	2x4	2x4	2x4	2x8	2x6	2x6	2x4	2x4	2x4	2x8	2x8	2x6	2x4	2x4	2x4
24	Lower frame	1x8		2x4	2x4	2x4	2x4	1x8		2x4	2x4	2x4	2x4	1x8		2x4	2x4	2x4	2x4	1x8	2x4	2x4	2x4	2x4	2x4
	Struts	1x6		2x4	2x4	2x4	2x4	1x8	1x6	2x4	2x4	2x4	2x4	1x8	1x6	2x4	2x4	2x6	2x6	1x8	2x4	2x4	2x4	2x4	2x6
	Diagonal	1x6	1x6	2x4	2x4	2x4	2x4	1x8	1x6	2x4	2x6	2x6	2x6	1x8	1x6	2x4	2x6	2x6	2x6	1x8	2x4	2x4	2x6	2x6	2x6
	Upper frame	2x8	2x6	2x4	2x4	2x4	2x4	2x8	2x6	2x6	2x4	2x4	2x4	2x8	2x8	2x6	2x6	2x4	2x4	2x8	2x8	2x6	2x6	2x4	2x4
28	Lower frame	1x8		2x4	2x4	2x4	2x4	1x8		2x4	2x4	2x4	2x4	1x8	2x4	2x4	2x4	2x4	2x4	1x8	2x4	2x4	2x4	2x4	2x4
	Struts	1x8		2x4	2x4	2x4	2x4	1x8		2x4	2x4	2x4	2x4	1x8	2x4	2x4	2x4	2x4	2x4	1x8	2x4	2x4	2x4	2x4	2x4
	Diagonal	1x8	1x6	2x4	2x4	2x4	2x4	1x8	1x6	2x4	2x6	2x6	2x6	1x8	2x4	2x4	2x6	2x6	2x6	1x8	2x4	2x4	2x6	2x6	2x6
	Upper frame	2x8	2x8	2x6	2x6	2x4	2x4	2x8	2x8	2x6	2x6	2x4	2x4	2x10	2x10	2x6	2x6	2x4	2x4	1x10	2x10	2x6	2x6	2x4	2x4
32	Lower frame	1x8		2x4	2x4	2x4	2x4	1x8		2x4	2x4	2x4	2x4	2x6	2x4	2x4	2x4	2x4	2x4	2x6	2x4	2x4	2x4	2x4	2x4
	Struts	1x8	1x6	2x4	2x4	2x4	2x4	1x8	1x6	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4
	Diagonal	2x8	1x6	2x4	2x6	2x4	2x6	2x8	1x6	2x4	2x6	2x6	2x6	2x8	2x4	2x4	2x6	2x6	2x6	2x8	2x4	2x6	2x6	2x6	2x6

*Crates 12 feet high in 6-foot widths and crates 10 feet high in 6-foot widths require 2x4 vertical joists supports when struts are 1 inch thick; all other sizes use horizontal joist supports.